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Collaboration, Knowledge-Sharing and Natural Hazard Risk Management in the Greater Pinery Provincial Park Region

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by

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Abstract

In Canada, parks and other forms of protected areas are visited by tens of millions of people annually. By their very nature, parks and protected areas present various risks that must be mitigated. Risk management is an area of research that is receiving increased attention because in recent years, natural hazards (e.g. effects the environment) and disasters (e.g. effects the environment and humans) have exacted significant economic, social, health, cultural, and environmental impacts on persons and communities across Canada. Natural hazards, which pose significant risks to the natural environment and those individuals who inhabit or visit them, are expected to increase in occurrence and severity because of climate change. Knowledge and knowledge management is vital to making informed decisions that aim to protect the health and well-being of visitors. Understanding the value in and having the capacity to access and use various forms of knowledge (including social science, natural science, local, Indigenous, and other forms of knowledge) when making decisions to help proactively and reactively respond to natural hazard risks is critical now and in the future.

This thesis focuses on tornadoes and wind events in the greater Pinery Provincial Park region to understand the risks that these natural hazards pose to visitors and how to best adaptively mitigate such risks in the face of climate change. The thesis employed a qualitative case study approach, which examined how knowledge of natural hazard risk management is (or is not) used, produced, shared, and managed within the greater Pinery Provincial Park region. Informing the research study design were Nguyen et al.'s (2017) *Knowledge-Action Framework* and Bennett et al.'s (2016) *Framework for Collaborative and Integrated Conservation Science and Practice*. 15 key informants participated in semi-structured, in-person interviews, that were collaboratively coded using an adapted version of Braun and Clarke's (2006) inductive, thematic approach, aided by NVivo 12 software, to discover 12 main themes, including: 1) Adaptive Management, 2) Collaboration and Partnerships, 3) Communication, 4) Knowledge Acquisition, 5) Knowledge Integration and Decision-making, 6) Knowledge Sharing and Exchange, 7) Planning, 8) Plans, Policies, and Regulations, 9) Relationships, 10) Resources and Capacity, 11) Responsibility and, 12) Risk Monitoring and Evaluation.

Thematic coding findings identified a number of diverse strengths (e.g., transparent internal communication and integration of natural science knowledge into decision-making), weaknesses (e.g., lack of collaboration and partnerships with Indigenous communities and an absent understanding of social science and its' value), and needs and opportunities (e.g. involvement of Public Health sector stakeholders in natural hazard risk management and more dedicated resources to support capacity).

The *Sendai Framework for Disaster Risk Reduction 2015-2030* was chosen to deductively frame the discussion. The goal of the *Framework* is to: "prevent new and reduce existing disaster risk through the implementation of integrated and inclusive economic, structural, legal, social, health, cultural, educational, environmental, technological, political and institutional measures that prevent and reduce hazard exposure and vulnerability to disaster, increase preparedness for response and recovery, and thus strengthen resilience" (UNDRR, 2015, p. 11). The *Framework's* first three priorities focused on: 1) understanding disaster risk, 2) strengthening disaster risk governance to manage disaster risk, and 3) investing in disaster risk reduction for resilience, effectively guided the discussion of the 12 main themes identified from the key informant's in-person interviews (UNDRR, 2015). The *Framework's* fourth priority focused on enhancing disaster preparedness for effective response and to "Build Back Better" in recovery, rehabilitation, and reconstruction (UNDRR, 2015).

Numerous detailed immediate-term and short-term recommendations, based on the 12 main themes identified through the inductive, thematic analysis, are put forward, including: 1) focusing efforts on proactive natural hazard risk management planning in anticipation climate change effects; 2) integrating social science knowledge, traditional ecological knowledge, Indigenous knowledge and other forms of knowledge more effectively into natural hazard risk management decision-making; 3) involving, more effectively, Public Health sector stakeholders in natural hazard risk management planning; and, 4) increasing availability and access to financial resources to support risk management activities. The implementation of such recommendations would support more effective adaptive natural hazard risk decision-making, planning and management in the region. Overall, the research study addresses a critical gap in parks and protected area and natural hazard research. It represents the first known study in Canada to examine how knowledge of natural hazard risk management is (or is not) used, produced, shared, and managed within a greater protected areas context.

Key words: parks and protected areas, knowledge mobilization, knowledge sharing, risk management, natural hazards, tornados, wind-events, natural science, social science, traditional ecological knowledge, Indigenous knowledge

Acknowledgments

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Chapter 1: Introduction

In recent years, natural hazards and disasters have exacted significant economic, social, health, cultural, and environmental impacts on persons and communities across Canada (Cox et al., 2019; Dotto et al., 2010; Yong & Lemyre, 2019). On June 17th, 2019, Canada declared a national climate emergency (Aiello, 2019). By declaring this emergency, Canada acknowledged that climate change is a real and urgent crisis, and that Canadians are feeling the impacts of climate change today from a variety of different natural hazards.

Parks and other forms of protected areas in Ontario are vulnerable to natural hazard and disaster events. Natural hazard disasters such as tornadoes and wind-related events are increasing in occurrence and severity in Canada (Cox et al., 2019; Dotto et al., 2010; Ontario Parks, 2021; Yong & Lemyre, 2019). Evidence indicates that exposure of persons and assets in all countries has increased faster than vulnerability has decreased, thus generating new risks and a steady rise in disaster-related losses (Center for Climate and Energy Solutions, 2021; Government of Ontario, 2001; IPCC, 2018). Furthermore, it is expected that climate change will result in extreme temperatures and increase the frequency and intensity of weather-related natural disasters such as drought and mid-latitude storms (Intergovernmental Panel on Climate Change, 2021).

Parks contain structures, infrastructure, and offer a wide range of activities for the millions of people who visit these areas annually. The diverse type, origin, and experience level of park visitors, and the inherent risks that cannot be managed or transferred away, in addition to the need to balance public recreation and safety with the protection of ecological and cultural integrity, makes visitor risk management in parks a difficult but necessary challenge (Eagles, 2013; Lawson & Manning, 2002). It also makes it essential that park agencies work with partners to strive to anticipate, plan for, and reduce natural hazard and natural disaster risk to more effectively protect the health and well-being of communities, their livelihoods, economic assets, park staff, and others. Because risk management is a shared responsibility, a successful risk management plan requires that all stakeholders coordinate efforts to identify and understand the nature of park resources, the risks to public safety that are present, and steps that can be taken to adaptively reduce unsafe conditions and practices.

Informing the research study design were Nguyen et al.'s (2017) *Knowledge-Action Framework*, a dynamic framework to help build empirical evidence in an organized manner and further understanding

of knowledge movement in the context of conservation and natural resource management, and Bennett et al.'s (2016) *Framework for Collaborative and Integrated Conservation Science and Practice*, a framework to provide practical guidance on overcoming ideological, institutional, knowledge, and capacity barriers, and to more effectively mainstream the social sciences in conservation science, practice, and policy. Additionally, socio-ecological theory and other theoretical models guided the approach to the research case study (e.g., Cvitanovic et al., 2016; Haltiwanger et al., 2010).

This SSHRC-funded research study is part of a larger pan-Canadian initiative designed to document and foster evidence informed decision-making. The initiative, called the Canadian Parks Research Network, has members from the academic community, environmental NGOs, and government agencies, all interested in advancing the efficacy of protected areas in Canada. A better understanding of how stakeholders with a role in natural hazard risk management: 1) respond to wind-related natural hazard risks, as well as 2) use and share different forms of wind hazard mitigation knowledge (e.g., natural science, social science, and traditional ecological knowledge, Indigenous knowledge, and other forms of local knowledge), will help to improve natural hazard risk management in parks and protected areas. Natural hazard risk management-related recommendations will be provided to stakeholders with a role in natural hazard risk management to support adaptive initiatives focused on enhancing the greater Pinery Provincial Park region to respond to future natural hazard risks and disaster events.

From a scholarly perspective, the multi-stakeholder and case study approach adopted here can be used to enhance understanding of the current capacity and role of parks and protected areas organizations and other stakeholders working in the greater Pinery Provincial Park region on natural hazard risk management. This is a critically under-researched area of study (Balluz et al., 2000; Hoekstra et al., 2010; Jones & Scott, 2006; Ministry of Natural Resources and Forestry, 2002; Mulrooney, 2003; Ontario Parks, 2012). From a practical perspective, this research will help foster long-term collaboration amongst stakeholders on risk management in the greater Pinery Provincial Park region. Enhancing collective understanding and ability to collaborate on natural hazard issues is important now and will be even more important considering future climate change (Klein et al., 2011; Olson et al., 2017; White et al., 2001). Overall, the research study will address a critical gap in the parks and protected area research by examining how knowledge of natural hazard risk management is (or is not) used, produced, shared, and managed within the greater Pinery Provincial Park region.

The thesis has been organized into seven chapters:

1) Introduction;
2) Literature Review;
3) Objectives;
4) Methods;
5) Results;
6) Discussion and Recommendations, and;
7) Conclusion.

Chapter 1 outlined the research study's context and provided an initial introduction to the research study's focus and approach. Chapter 2 provides a literature review to situate the research and give context for relevant topics such as: parks and protected areas, visitation and tourism, risks and risk management, climate change, natural hazards, tornadoes and wind-events, adaptation and adaptive capacity, governance and adaptive governance, and knowledge management. The three objectives of this research study are outlined in Chapter 3. Chapter 4 describes the methodology used in this research, including the case study area, case study approach, research design, in-person interviews, data preparation and analysis. Chapter 5 outlines in detail the findings of the research, which are thoroughly discussed in Chapter 6. Recommendations are also visually presented in Chapter 6. The thesis concludes with Chapter 7, which provides a summary of the research study and final critical reflections. The references used throughout this thesis are also listed, followed by Appendices A, B and C for supplementary materials, such as in-person interview questions, quotation summary tables and a code table.

Chapter 2: Literature Review

Parks and protected areas, regardless of their designation, are areas where risk is present, climate change and natural hazards directly influence, and knowledge is used, produced, managed, and shared. Risk management is an area of research which is receiving increased emphasis due to the unpredictable world in which we live. Natural hazards pose monumental risks to the natural environment and those individuals who inhabit or visit these areas. Knowledge is vital to the holistic understanding of the world. While knowledge production is an essential exercise, knowledge should be actively managed and shared to prove its practical purpose (Cvitanovic et al., 2015; Cvitanovic et al., 2016; Fazey et al., 2012; Klein et al., 2011; Olson et al., 2017; White et al., 2001)

The following literature review highlights how knowledge of natural hazard risk management is managed within Canada's parks and protected areas. The literature review begins with an overview of parks and protected areas globally, in Canada, and lastly in Ontario. It then explores parks and protected areas with a focus specifically on tourism and visitation, and the management issues that arise as a result. The literature review discusses the concept of risk, and the need to manage risks in parks and protected areas. Climate change as an emerging risk management issue, natural hazard risk management, and specifically tornadoes and wind-events as natural hazard issues, is thoroughly explored. After a discussion on adaptation, adaptive capacity, governance, and adaptive governance, the challenge of knowledge management in climate change and natural hazard risk management is examined. Finally, the importance of knowledge mobilization in enhancing adaptive capacity to respond to emerging natural hazard risk management issues will be explored.

2.1 Parks and Protected Areas: A General Overview

Parks and protected areas can be found all over the world. Research pertaining to parks and protected areas is an actively growing area of research. The International Union for Conservation of Nature (IUCN) (2018) defines parks and protected areas as: "clearly defined geographical spaces, recognised, dedicated and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values." Protected areas can be classified into one of six management categories developed by the IUCN, including: strict nature reserve (Ia); wilderness area (Ib); national park (II); natural monument or feature (III); habitat/species management area (IV); protected landscape or seascape (V); and protected areas with sustainable use of natural resources (VI) (Dudley, 2008).

Canada's protected areas represent a significant contribution to the protection of global biodiversity (Environment and Climate Change Canada, 2021). At the end of 2020, Environment and Climate Change Canada's (ECCC) Canadian Protected and Conserved Areas Database (CPCAD) indicated that over 9,000 sites conserve 12.5% of land and freshwater area (including 11.7% in protected areas) and 13.8% of its marine territory (including 8.9% in protected areas) (Environment and Climate Change Canada, 2021). Over 95% of Canada's protected areas are managed by government (e.g., national parks and provincial/territorial parks), and the majority of which (62%) fall into IUCN category II (national monument or feature) (Environment and Climate Change Canada, 2021).

The *2021 State of Ontario's Protected Areas Report* indicated that there are: *"*340 provincial parks and 295 conservation reserves covering an area of 9.5 million hectares, or about nine per cent of Ontario*"* (Ontario Parks, 2021, p.1). Regulated provincial parks and conservation reserves have been formally designated by a regulation under the *Provincial Parks and Conservation Reserves Act* (PPCRA). The objectives of provincial parks and conservation reserves are as follows:

Provincial parks:

- To permanently protect representative ecosystems, biodiversity and provincially significant elements of Ontario's natural and cultural heritage, and to manage these areas to ensure that ecological integrity is maintained.
- To provide opportunities for ecologically sustainable outdoor recreation opportunities and encourage associated economic benefits.
- To provide opportunities for residents of Ontario and visitors to increase their knowledge and appreciation of Ontario's natural and cultural heritage.
- To facilitate scientific research and to provide points of reference to support monitoring of ecological change on the broader landscape. (Government of Ontario, 2019)

Conservation reserves:

- To permanently protect representative ecosystems, biodiversity and provincially significant elements of Ontario's natural and cultural heritage. And to manage these areas to ensure that ecological integrity is maintained.

- To provide opportunities for ecologically sustainable land uses, including traditional outdoor heritage activities and associated economic benefits.
- To facilitate scientific research and to provide points of reference to support monitoring of ecological change on the broader landscape. (Government of Ontario, 2019)

Provincial parks are organized into six classes based upon their purpose. About one third of Ontario's 340 regulated provincial parks are actively operated to provide recreation opportunities, facilities, and services (Ontario Parks, 2021). All provincial parks are planned and managed to protect natural and cultural values, conserve biodiversity, and support research and monitoring. *Table 1* identifies the types of protected areas found in Ontario and outlines each protected area's unique objectives.

Table 1 Types and Objectives of Protected Areas in Ontario

Type of Ontario Protected Area	Objective(s)
Nature Reserve Class Park	• Protect (vary in the special degree of protection they are provided) representative ecosystems and provincially significant elements of Ontario's natural heritage, including distinctive natural habitats and landforms, for their intrinsic value, to support scientific research, and to maintain biodiversity (Gray et al., 2009, p. 150)
Wilderness Class Park	• Preserve elements of geological, ecological, and species diversity • Perpetuate or manage natural processes • Act as ecological benchmarks • Promote scientific research • Provide outdoor education and heritage appreciation opportunities (Gray et al., 2009, p. 150)
Natural Environment Class Park	• Protect geological, ecological, and species diversity • Perpetuate or manage natural processes • Act as ecological benchmarks • Promote scientific research • Provide recreation, outdoor education, and heritage appreciation opportunities (Gray et al., 2009, p. 151)
Waterway Class Park	• Protect geological, ecological, and species diversity • Perpetuate or manage natural occurring processes • Act as ecological benchmarks • Promote scientific research

	• Provide outdoor education and heritage appreciation opportunities (Gray et al., 2009, p. 151)
Recreational Class Park	• Protect geological, ecological, and species diversity • Perpetuate or manage natural occurring processes • Serve as ecological benchmarks • Promote scientific research • Provide opportunities for outdoor education and nature appreciation (Gray et al., 2009, p. 151)
Conservation Reserves	• Protect significant natural and cultural features while providing opportunities for a variety of compatible traditional activities (e.g. fishing, hunting, trapping) • Allow and are important for scientific research and environmental monitoring (Government of Ontario, 2014)
Cultural Heritage Class Parks	• Preserve significant historical and archaeological assets • Provide education and heritage appreciation opportunities • Promote scientific research • Provide recreational opportunities where appropriate • Protect natural heritage assets (Gray et al., 2009, p. 151)
Wilderness Areas	• Preserve areas in their natural state to protect flora and fauna, these areas are regulated under the *Wilderness Areas Act* • Allow research and educational activities to be carried out to help improve local knowledge about historical, aesthetic, scientific or recreational values (Government of Ontario, 2014; Government of Ontario, 2017)
Algonquin Provincial Park Recreation/Utilization Zone	• Protect geological, ecological, and species diversity • Perpetuate or manage natural occurring processes • Serve as ecological benchmarks • Promote scientific research • Provide opportunities for outdoor education and nature appreciation • Permit forest management activities (Gray et al., 2009, p. 151)

Parks and protected areas play an important role in Ontario's efforts to conserve nature, cultural heritage and provide opportunities for tourism and recreation (Ontario Parks, 2021). Ontario Parks is dedicated to meeting four objectives, while maintaining or enhancing ecological integrity: 1) protection of natural and cultural features; 2) provision of ecologically sustainable outdoor recreation; 3) natural and cultural heritage education; and, 4) fostering research (Ontario Parks, 2021).

As noted in the first two of the four objectives above, provincially governed parks and protected areas in Ontario operate under a dual mandate of conservation and visitor use, which involves balancing ecological integrity: "a condition in which biotic and abiotic components of ecosystems and the composition and abundance of native species and biological communities are characteristic of their natural regions and rates of change and ecosystem processes are unimpeded" (*Provincial Parks and Conservation Reserves Act, S.O. 2006, c.12*. s. 5 (2)), and nature-based tourism activities (Weber et al., 2019, p. 1318).

The PPCRA similarly reinforces the dual mandate, noting that:

> the purpose of this Act is to permanently protect a system of provincial parks and conservation reserves that includes ecosystems that are representative of all of Ontario's natural regions, protects provincially significant elements of Ontario's natural and cultural heritage, maintains biodiversity and provides opportunities for compatible, ecologically sustainable recreation. *(Provincial Parks and Conservation Reserves Act, S.O.* 2006, c.12. s. 1)

2.2 Visitation, Tourism and Canada's Parks and Protected Areas

As noted above, visitation and provision of outdoor recreation opportunities is a legislative objective of many parks and other forms of protected areas in Canada and Ontario. Parks and protected area visitation and tourism has experienced a steady increase in recent years. Globally, parks and protected areas receive approximately: "8 billion visits per year. Of the 8 billion visits annually, more than 80% are those visits are to parks and protected areas in Europe and North America" (Balmford et al., 2015, p. 1). Val (2012) states that: "total visits to Canada's parks in 2009 were calculated to be some 70 million" (p. 341). In 2019, Parks Canada specifically welcomed approximately 24,888,241 visitors and Ontario Parks received more than 10 million visits (Government of Ontario, 2020; Parks Canada, 2021). The dual mandate that Canada's parks and protected areas operate under, which involves balancing ecological integrity and nature-based tourism activities, is sometimes challenging and conflicts have the potential to arise (Ministry of Natural Resources and Forestry, 2017).

2.2.1 Tourism and Visitor Management Issues in Canada's Parks and Protected Areas

Eagles (2013) notes that the present body of literature on outdoor recreation and park tourism, containing theoretical underpinnings, empirical findings, and management implications, is well-

established. In the last decade, Canada's parks and protected area's visitation and tourism has increased dramatically beyond objectives defined in current management plans (Canadian Parks and Wilderness Society, 2020). As a result of this increase, park users and managers have observed an array of environmental, social, and cultural impacts that are both beneficial and pose threats to Canada's parks and protected areas (Canadian Parks and Wilderness Society, 2020). According to Eagles (2002), parks and protected area's visitation and tourism yields numerous benefits (*Table 2*). The three overarching benefits of parks and protected area's visitation and tourism include: 1) enhancing economic opportunity, 2) protecting natural and cultural heritage, and 3) enhancing quality of life (Eagles et al., 2002).

Table 2 Potential Benefits of Parks and Protected Area's Visitation and Tourism (Eagles et al., 2002, p. 24)

Potential Benefits of Parks and Protected Areas Visitation and Tourism	
Enhancing economic opportunity	• Increases jobs for local residents • Increases income • Stimulates new tourism enterprises, and stimulates and diversifies the local economy • Encourages local manufactures of goods • Obtains new markets and foreign exchange • Improves living standards • Generates local tax revenues • Enables employees to learn new skills • Increase funding for protected areas and local communities
Protecting natural and cultural heritage	• Protects ecological processes and watersheds • Conserves biodiversity (including genes, species and ecosystems) • Protects, conserves and values cultural and built heritage resources • Creates economic value and protects resources which otherwise have no perceived value to residents, or represent a cost rather than a benefit • Transmits conservation values, through education and interpretation • Helps to communicate and interpret the values of natural and built heritage and of cultural inheritance to visitors and residents of visited areas, thus building a new generation of responsible consumers • Supports research and development of good environmental practices and management systems to influence the operation of travel and tourism

	businesses, as well as visitor behaviour at destinations • Improves local facilities, transportation, and communications • Helps develop self-financing mechanisms for protected area operations
Enhancing quality of life	• Promotes aesthetic, spiritual, and other values related to well-being • Supports environmental education for visitors and locals • Establishes attractive environments for destinations, for residents as much as visitors, which may support other compatible new activities, from fishing to service or product-based industries • Improves intercultural understanding • Encourages the development of culture, crafts and the arts • Increases the education level of local people • Encourages people to learn the languages and cultures of foreign tourists • Encourages local people to value their local culture and environments

The economic opportunity that parks and protected areas-related visitation and tourism provides is significant but often under reported and recognized. Parks and protected areas-related visitation and tourism: *"*globally generates approximately $600 billion dollars annually in direct in-country expenditure and $250 billion dollars annually in consumer surplus. These figures dwarf current, typically inadequate spending on conserving parks and protected areas" (Balmford et al., 2015). Visitors to Canada's parks and protected areas, on the other hand, spent an estimated $4.4 billion in 2009. According to Val (2012), for every dollar of agency funding spent on parks, $5.70 is returned to the Canadian economy through visitor expenditures.

Visitation and tourism can also threaten Canada's parks and protected areas. If mismanaged, high visitation to Canada's parks and protected areas can result in the exploitation of Canada's parks and protected area's natural resources. Inadequate management of high visitation can also result in personal safety risks for visitors. Such risks include overcrowding and the inability to provide adequate essential services. Lawson and Manning (2002) identified three dimensions: 1) social, 2) resource and 3) management, that are associated with visitor's recreational experiences in parks and protected areas. Additionally, these three dimensions, if managed inadequately, have the potential to threaten visitation

and visitor safety in protected areas (Canadian Parks and Wilderness Society, 2020). Lawson and Manning's (2002) social dimensions focused on the number of other people encountered, resource dimensions focused on the amount of human impact in an area, and management dimensions focused on regulations limiting the number of people. Findings from Lawson and Manning (2002) research study suggest that:

> visitors would be willing to tolerate and support management restrictions, including use limits, to achieve desired social and resource setting attribute conditions; parks and protected area's experiences can be protected from substantial decline by keeping conditions from deteriorating beyond such 'threshold' levels; and visitors would prefer parks and protected area's that emphasize solitude through relatively restrictive management actions over a more congested wilderness setting with limited management restrictions (p. 308-9).

Visitor's recreational experiences in parks and protected areas are dependent on visitor management. The Canadian Parks and Wilderness Society (CPAWS) (2020) defines visitor management as: "the process of managing human use to maintain or achieve desired conditions or experiences" (p. 19). Visitor use management strategies, specifically visitor use management frameworks, were explored in great detail by CPAWS. CPAWS states that a successful visitor use management framework requires robust human use and social science data (Canadian Parks and Wilderness Society, 2020). When this data is placed within the context of monitoring focused on ecological objectives, a holistic understanding of visitor use in parks or protected areas is achieved (Canadian Parks and Wilderness Society, 2020). Adaptive management is a critical component of successful visitor use management frameworks.

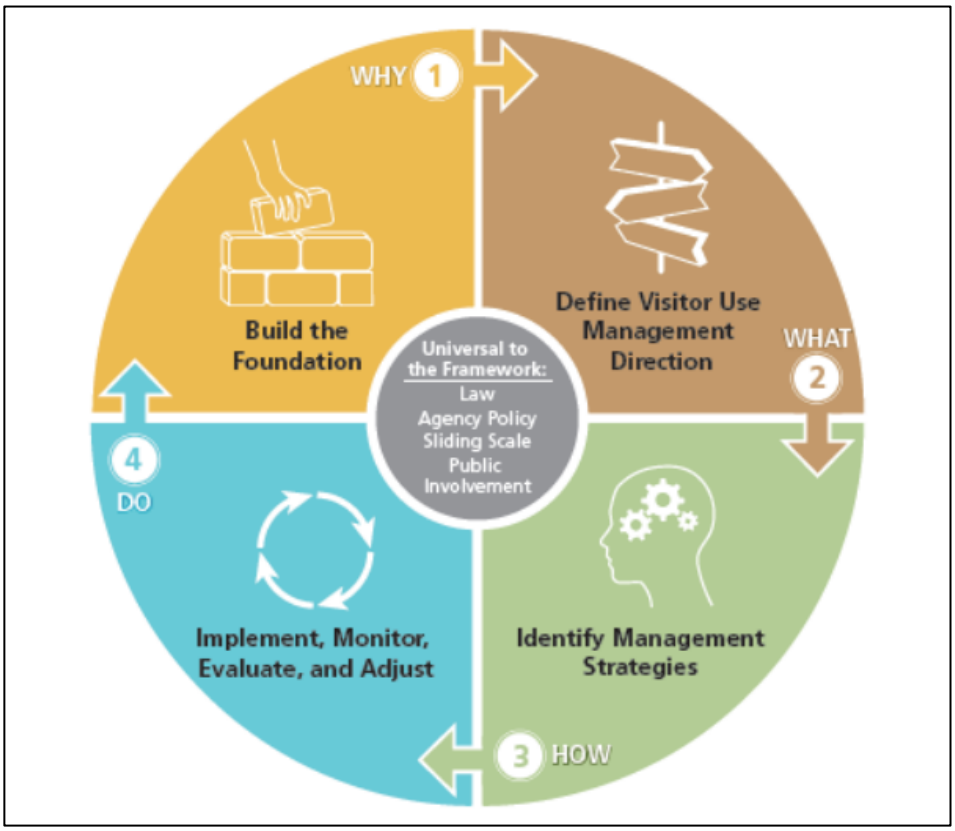

Figure 1 Visitor Use Management Framework Applied in US National Parks (Canadian Parks and Wilderness Society, 2020, p. 38)

Figure 1 is an example of a visitor use management framework applied in US National Parks. The *Framework* applied to US National Parks follows a continuous cycle of: 1) building a foundational understanding of why visitor use management is important; 2) defining visitor use management direction; 3) identifying management strategies; and, 4) implementing, monitoring, evaluating, and adjusting visitor use management (Canadian Parks and Wilderness Society, 2020).

A high-quality natural environment for sustained and satisfying outdoor recreational use is one of the goals of parks, protected areas, and outdoor recreation planning and management more broadly (Eagles, 2013). Manning's (1999) Outdoor Recreation Management Structure, a standard, normative planning model, is a common approach used when planning and managing parks, protected areas, and outdoor recreation activities (Eagles, 2013). There are four steps a part of Manning's (1999) *Outdoor Recreation Management Structure*: "(1) inventory existing recreation conditions; (2) determine management objectives; (3) develop management prescriptions; and (4) monitor and evaluate implementation" (Eagles, 2013, p. 13) (*Table 3*).

Table 3 Manning's (1999) Outdoor Recreation Management Structure (Eagles, 2013, p. 13)

Step 1	• Inventory existing recreation conditions (natural, social and management environment)
Step 2	• Determine management objectives (create and chose alternatives, develop management objectives, indicators, and standards)
Step 3	• Develop management prescriptions (determine level, location, and types of management)
Step 4	• Monitor and evaluate success (monitor indicators and evaluate standards)

It is important to note that Manning's (1999) approach assumes that the organization has the capacity to implement the steps in *Table 3*. Sufficient capacity is attained by an organization if capacity is developed within the following nine areas: "1) defining its mission; 2) performance assessment; 3) accountability; 4) effective management structure; 5) effective management processes; 6) sufficient human resources; 7) sufficient financial resources; 8) sufficient information; and 9) appropriate infrastructure" (Eagles, 2013, p. 14). In the last 15 years the evaluation of management effectiveness has emerged; furthermore, becoming an important subfield within parks and protected areas management (Eagles, 2013; Hockings et al., 2000). Eagles (2013) emphasises that:

> since successful management is ultimately dependent upon the capacity of the organization to undertake management, the issue of management capacity is vital to planning, management, and ultimately management effectiveness (p. 14).

When making rational, defensible trade-offs between resource protection and visitor access, protected area managers should look to visitor use management decision-making frameworks to provide a structure for organizing information (Canadian Parks and Wilderness Society, 2020). Visitor use management frameworks "assess visitor impacts and determine management actions and strategies to minimize or prevent impacts caused by visitation and tourism" (Canadian Parks and Wilderness Society, 2020, p. 21) and have been used to manage visitor use in parks and protected areas. However, such frameworks inadequately address risk. Intentionally incorporating considerations of risk into visitor use management frameworks would benefit parks and protected areas management. High visitation and tourism, in addition to climate change, are immediate concerns for Ontario's Great Lakes parks and protected areas, prompting the need to reconsider visitor use management frameworks through a risk lens. Human use data and social science will be required to understand levels of visitation, where visitors

go, what forms of recreation visitors participate in, and any possible risks visitors may experience (Canadian Parks and Wilderness Society, 2020).

2.3 Concept of Risk

The concept of risk, the fact that individuals face an enormous variety of risks on a daily, even hourly, basis, is not new (Palenchar & Heath, 2002). According to the Intergovernmental Panel on Climate Change (IPCC) (2020), risk is defined as: "the potential for adverse consequences for human or ecological systems, recognising the diversity of values and objectives associated with such systems" (p. 4). When discussing risk in the context of climate change, risks can arise from potential impacts of climate change, in addition to human responses to climate change (IPCC, 2020). The IPCC outlines relevant adverse consequences which include those on: "lives, livelihoods, health and wellbeing, economic, social and cultural assets and investments, infrastructure, services (including ecosystem services), ecosystems and species" (2020, p. 4). Risk is a complex concept, "with its conceptualizations depending on epistemological perspectives and methodological approaches of the various research disciplines it is embedded within" (Gstaettner et al., 2018, p. 1784). The IPCC (2014) Framework, displayed in *Figure 2,* visually provides an understanding of the risks of climate variability and climate change.

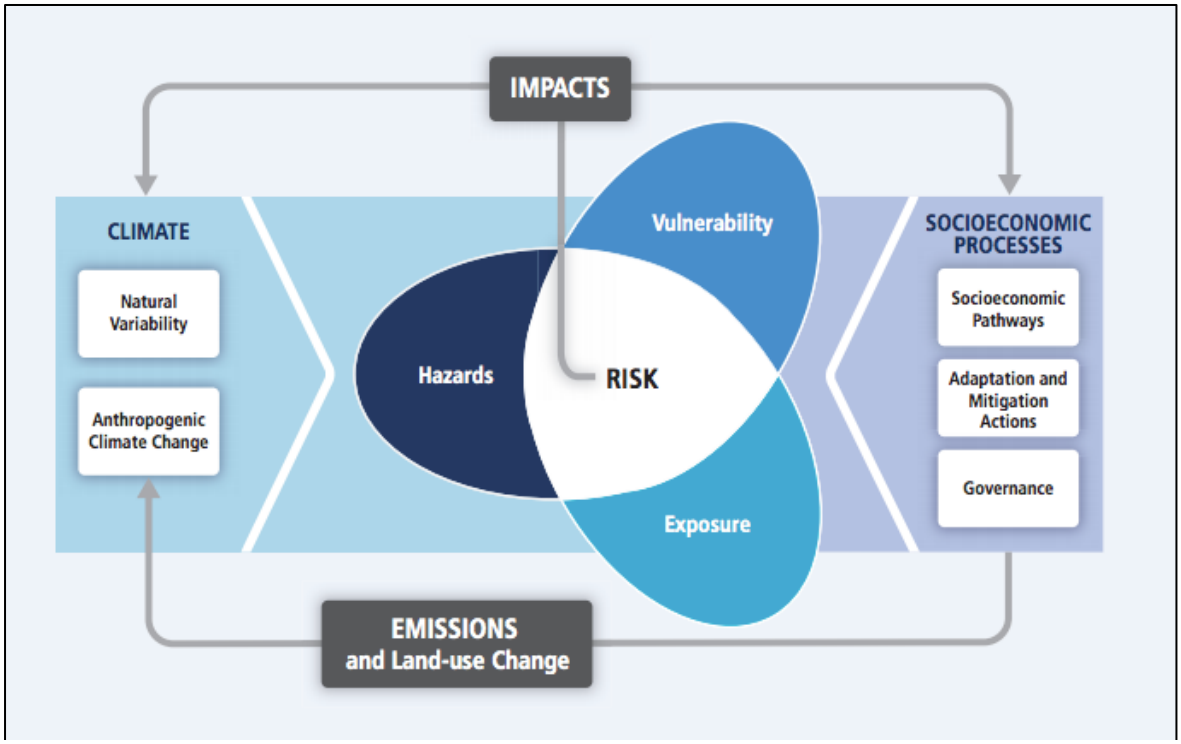

Figure 2 Risks of Climate Variability and Change Framework (IPCC, 2014, p. 3)

The IPCC (2014) explains that the: "risk of climate-related impacts results from the interaction of climate-related hazards, with the vulnerability and exposure of human and natural systems" (IPCC, 2014, p. 3). Hazards, exposure, and vulnerability are all affected by changes in the climate system and socioeconomic processes (IPCC, 2014).

2.3.1 Managing Risk in Parks and Protected Areas

Related to the concept of risk, is risk management which is: *"*an important and growing area of research in the uncertain world*"* (Olson & Wu, 2017, p. 17). The IPCC (2020) defines risk management as: "the plans, actions, strategies or policies to reduce the likelihood and/or magnitude of adverse potential consequences, based on assessed or perceived risks" (p. 5). When attempting to manage risk, risks fall into two groups: 1) those that reduce risk; and, 2) those that transfer or share risk (Fazey et al., 2004). Decisions often are made to certain level of risk acceptance (Etkin et al., 2004). The effective management of risk requires many stakeholders. Etkin et al. (2004) suggests that *"*successful risk management requires broad-based engagement and a multi-disciplinary, systematic approach*"* (p. 1). In recent years, the literature focused on risk management has correlated to the growing organizational awareness of corporate and social responsibilities (Alhawari et al., 2012). As per *Figure 3*, Becken et al. (2007) developed a framework that focuses on risk-based approaches for identifying and assessing options for managing the adverse consequences of climate change; however, this *Framework* could also be utilized to aid risk management efforts more generally.

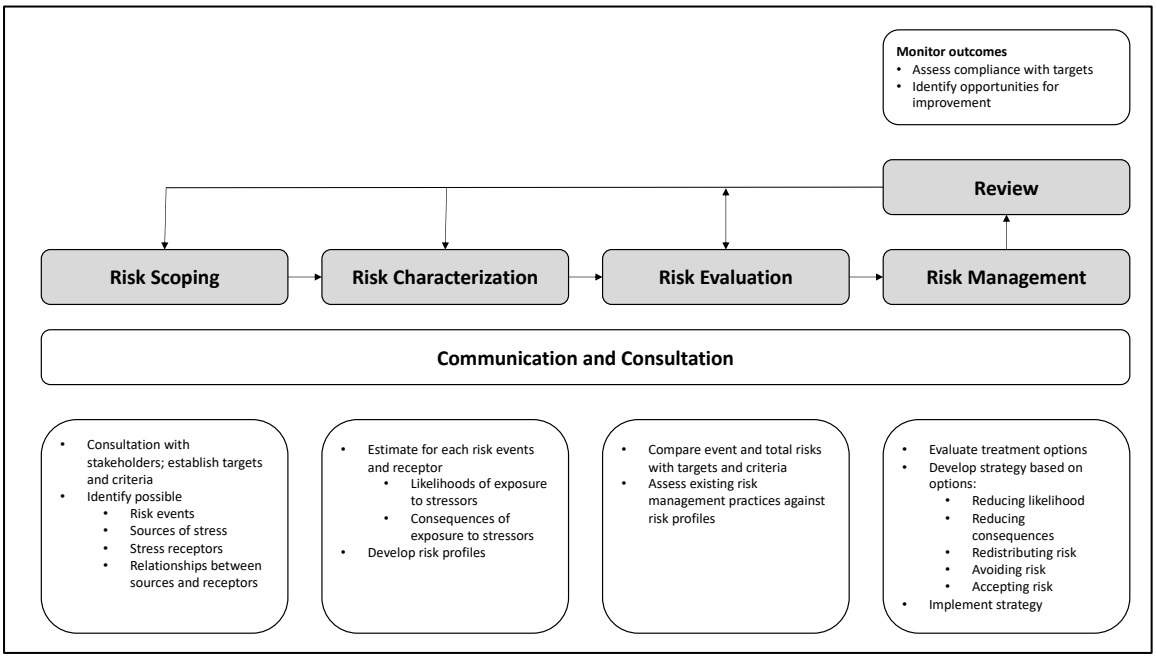

Figure 3 Risk-Based Approaches (Becken & Hay, 2007, p. 228)

For example, any risk management project could be subjected to the risk scoping, risk characterization, and risk evaluation, steps outlined by the authors. This *Framework* also includes a "review" step, which is critical when managing risk. With each new risk, there may be a need to alter (adapt) the standard risk management strategy employed. A review of any risk management efforts employed should be regularly conducted to ensure optimal management if a similar risk-event were to occur in the future. The goal of risk management is to ultimately remove the risk from the equation.

The notion of "trust" in relation to stakeholders has been noted by many as being a critical component of risk management (Cole & Murphy, 2014; Heath & Palenchar, 2000; Palenchar & Heath, 2002; Palenchar & Heath, 2007; Steelman & McCaffrey, 2013; Trettin & Musham, 2000; Wachinger et al., 2013). The public's trust in risk managers, research suggests, greatly dictates the success of risk management initiatives. However, many scholars have noted that the role of trust in risk management is an area requiring further research.

2.3.2 Climate Change as an Emerging Risk Management Issue

The IPCC (2014) defines climate change as: "a change in the state of the climate, that can be identified by changes in the mean or the variability of its properties, and that persists for an extended period, typically decades or longer" (p. 120). The IPCC (2018) estimated that anthropogenic global

warming is increasing at 0.2°C per decade. The *2018 Global Warming of 1.5°C: IPCC Special Report* indicated that: "depending on the temperature dataset considered, 20–40% of the global human population live in regions that, by the decade 2006–2015, had already experienced warming of more than 1.5°C above pre-industrial in at least one season" (p. 51). The consequences of global warming are already able to be seen through extreme weather (IPCC, 2018). While extreme weather is a known climate-related risk, other climate related risks will depend on the magnitude, rate, and duration of warming in the future (IPCC, 2018).

Climate change is and will affect everyone and everything (United Nations, 2021). The United Nations established 17 Sustainable Development Goals, pictured in *Figure 4*, as a "universal call to action to end poverty, protect the planet and improve the lives and prospects of everyone, everywhere" (United Nations, 2021). Sustainable Development Goal 13: Climate Action, demands urgent action to be taken to tackle climate change and its' impacts (United Nations, 2021). In order to ensure the measurability of Goal 13, five targets were outlined:

1) Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries,
2) Integrate climate change measures into national policies, strategies and planning,
3) Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning,
4) Implement the commitment undertaken by developed-country parties to the United Nations Framework Convention on Climate Change to a goal of mobilizing jointly $100 billion annually by 2020 from all sources to address the needs of developing countries in the context of meaningful mitigation actions and transparency on implementation and fully operationalize the Green Climate Fund through its capitalization as soon as possible, and
5) Promote mechanisms for raising capacity for effective climate change-related planning and management in least developed countries and small island developing States, including focusing on women, youth and local and marginalized communities (United Nations, 2021).

Sustainable Development Goal 13 identifies climate change as an emerging issue, and the five targets guide climate change-related risk management efforts.

Figure 4 United Nation's 17 Sustainable Development Goals (United Nations, 2021)

2.3.2.1 Natural Hazard Risk Management

The IPCC defines a hazard as: "the potential occurrence of a natural or human-induced physical event that may cause loss of life, injury, or other health impacts, as well as damage and loss to property, infrastructure, livelihoods, service provision, and environmental resources" (IPCC, 2012, p. 560). Relatedly, natural hazards are defined as: *"*natural, physical environmental processes that occur near or at the surface of the earth that can produce unexpected events of unusual magnitude or severity*"* (Government of Ontario, 2001), and are sometimes referred to as 'Acts of God' (Dotto et al., 2010). What differentiates natural hazards from human hazards is the absence or presence of malicious intent (Ayyub et al., 2007). Natural hazards are deemed natural "disasters" when human lives are lost (Government of Ontario, 2001). Others have referred to a natural hazard (threat) as a natural disaster (event) that has not yet occurred (National Oceanic and Atmospheric Administration, 2021).

Natural hazards have been an area of focused research, given that *"*the outcomes of natural hazards can be catastrophic, frequently resulting in damage to property, injury to humans and other organisms, and tragically even loss of life*"* (Government of Ontario, 2001). Canada is a country characterized by natural hazards given its' large land mass, diverse geography, and distinct climates (Dotto et al., 2010). Natural hazard occurrences have a long history in Ontario, and natural hazard events are expected to increase in southwestern Ontario specifically in response to climate change (Government of Ontario, 2001; Colombo, 2010; Dotto et al., 2010; Public Safety Canada, 2011; Emergency Management Ontario

MCSCS, 2012). Windstorms and tornadoes are examples of the types of natural hazards which regularly occur in southwestern Ontario (*Figure 5*).

Natural Hazards				
Blizzard	Earthquake	Hurricane	Tornado	Volcano Eruption
Disease Outbreak	Extreme Temperature	Landslide	Tropical Storm	Wildfire
Drought	Flooding	Meteorite/Asteroid	Tsunami	Windstorms

Figure 5 Types of Natural Hazards (Ayyub et al., 2007, p. 792)

Emergency management adopts an all-hazards approach in Canada (Public Safety Canada, 2017). Public Safety Canada (2017) explains that an all-hazards approach increases efficiency, as it recognizes and integrates common emergency management elements for all hazard types and across all emergency management plans. Hazard specific sub-components are supplemented in plans to fill gaps only as required (Public Safety Canada, 2017).

2.3.2.2 Tornadoes and Wind-events as Natural Hazard Risk Management Issues

Tornadoes are defined as "violently rotating columns of air, in contact with the ground, either pendant from a cumuliform cloud or underneath a cumuliform cloud, or often (but not always) visible as a funnel cloud" (Emergency Management Ontario MCSCS, 2012). There are various warning signs that indicate a tornado may form. For example: severe thunderstorms, very dark clouds highlighted with a few green or yellow areas, a rumbling sound, and a funnel cloud forming at the base of a dark cloud, are all warning signs that indicate a tornado may form (Canadian Red Cross, 2021). It is important to know the difference between a tornado watch and a tornado warning. A tornado watch is issued when a tornado may be in the area; furthermore, when the watch is issued, it is important to closely monitor local weather reports for more information (Canadian Red Cross, 2021). When a tornado warning is issued, a tornado is in the area and expected to hit very soon.

Tornado season is usually between April and September, with the strongest winds in June and July (Canadian Red Cross, 2021). Except for the United States, Canada gets more tornadoes than any other country in the world, and southwestern Ontario and parts of the southern Prairies are struck most often (Public Safety Canada, 2015). For example, on May 25, the first tornado of 2021 occurred in Little Antler Lake, Ontario at 6:35 p.m. It had an estimated maximum wind speed of 190 km/h, a preliminary track length of 33.4 km and maximum path width of 260 metres (Howes, 2020). The tornado was

assigned an EF-2 classification (Howes, 2020). Information obtained from the University of Western Ontario's Northern Tornadoes Project indicated that 2020 was an active tornado season:

> Ontario, which kicked off into high gear with what was eventually deemed an outbreak, even before the season technically started. Following the June 10th event, in which seven tornadoes were confirmed, there have been 23 more verified in the province, including another outbreak on July 19. The latest tornadoes occurred on Thursday, Sept. 3. As of Sept. 6, Canada has had 66 tornadoes in 2020. With 30 tornadoes confirmed in Ontario so far, with more events under investigation, the province has had the most tornadoes in the country to date, far ahead of Alberta's 12, the second-highest total in Canada. (Howes, 2020)

Tornadoes are classified using the Enhanced Fujita Scale or EF-Scale in Canada. The Enhanced Fujita Scale or EF-Scale was adopted in 2013, and it is a more modern and improved version of the original Fujita Scale or F-Scale. The Enhanced Fujita Scale is a six-point scale that goes from zero (weakest) to five (strongest), as summarized in *Table 4* (NOAA, 2021). According to Public Safety Canada, up until 2015, a F-5 tornado had never occurred in Canada, and further explained that: "45 percent are F-0, 29 percent are F-1, 21 percent are F-2, four percent are F-3, and just one percent are F-4" (Public Safety Canada, 2015).

Table 4 Enhanced Fujita Scale (NOAA, 2021)

	Enhanced Fujita Scale Rating	**Enhanced Fujita Scale Wind Speed Rounded to 5 km/h**
Weakest	0	90-130
	1	135-175
	2	180-220
	3	225-265
	4	270-310
Strongest	5	315+

When tornado-related damage is surveyed, it is compared to a list of 31 damage indicators (DI), some of which include: small barns and farm outbuildings (SBO), one or two-family residences (FR12), institutional building (e.g. hospital, government, university) (IB), tree-hardwood (TH), tree-softwood (TS); etc. (NOAA, 2021). Each damage indicator (DI) includes unique degrees of damage (DoD), to help

better estimate the range of wind speeds the tornado likely produced. For example: the tree-hardwood (TH) damage indicator's (DI's) unique degrees of damage (DoD) include: small limbs broken (up to 1" diameter); large branches broken (1"-3" diameter); trees uprooted; trunks snapped; trees debarked with only stubs of largest branches remaining (NOAA, 2021) (*Table 5).* Upon evaluation, a rating from EF0 to EF5 is assigned.

Table 5 Damage Indicator (DI) Tree-Hardwood (TH): Degrees of Damage (DoD) (NOAA, 2021)

DOD	Damage Description	EXP: Expected (km/h)	LB: Lower Bound (km/h)	UB: Upper Bound (km/h)
1	small limbs broken (up to 1" diameter)	60	48	72
2	large branches broken (1"-3" diameter)	74	61	88
3	trees uprooted	91	76	118
4	trunks snapped	110	93	134
5	trees debarked with only stubs of largest branches remaining	143	123	167

Environment and Climate Change Canada created the map below, *Figure 6*, that visually displays all verified tornadoes in Canada from 1980 to 2009. *Figure 6's* findings align with additional research which suggest that the presence of stronger storms because of changing climate is believed to subject southwestern Ontario to heightened occurrences of natural hazard events (Balluz et al., 2000; Government of Canada, 2018; Hoekstra et al., 2010).

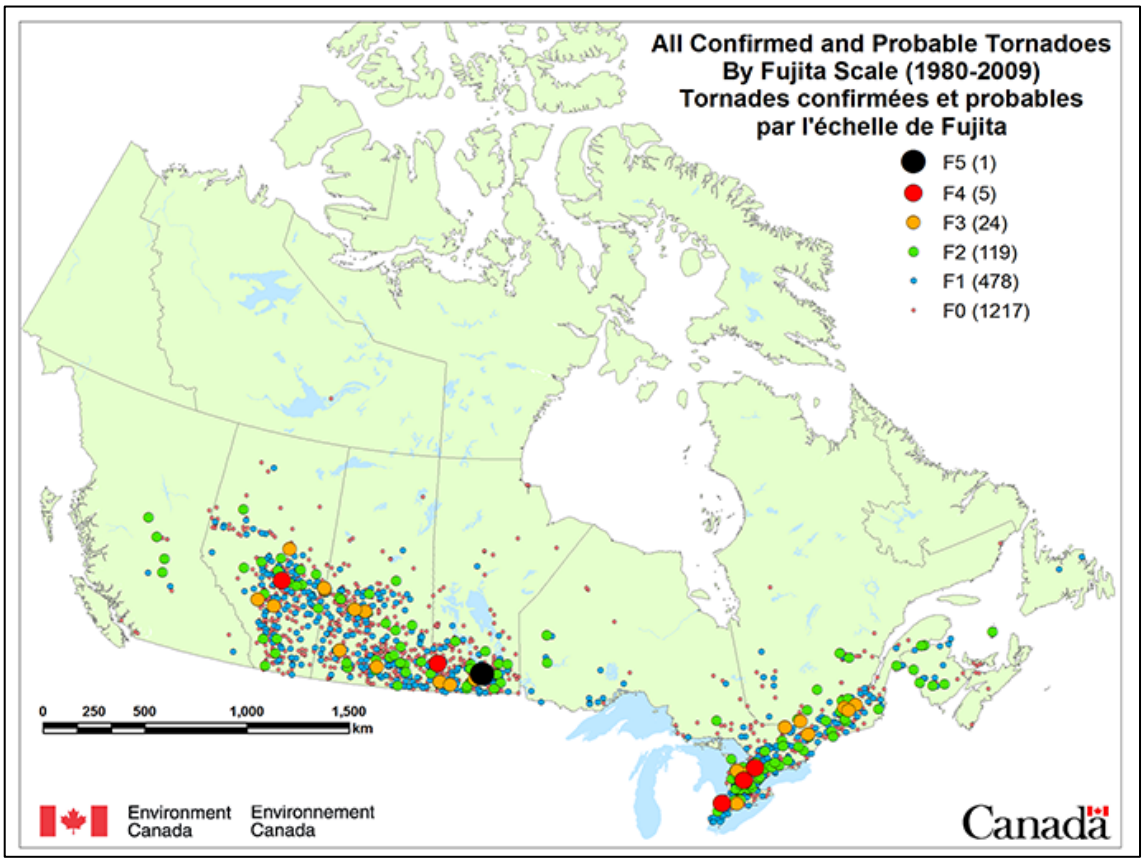

Figure 6 All Verified Tornadoes by Fujita Scale (1980-2009) (Environment and Climate Change Canada, 2017)

The occurrence and severity of natural hazards is expected to increase in the future due to climate change. The IPCC (2018) states that tornadoes are not well observed; therefore, tornadoes pose a significant natural hazard risk management challenge, a challenge which is amplified in the face of climate change. Tornadoes are also complex phenomena to understand and, therefore, manage given that: 1) competing physical processes may affect future trends making it difficult to understand tornado phenomena; 2) tornadoes are geographically too small to be well simulated by climate models; 3) shortcomings in tornado simulations have hindered understanding of the phenomena; 4) data inhomogeneities and inadequacies in monitoring systems result in low confidence when observing trends in small scale tornado phenomena; and, 4) few studies have focused on extreme wind projections and tornadoes (Center for Climate and Energy Solutions, 2021; IPCC, 2018). Lastly, as population density increases and remote areas are populated, understandings and management of tornadoes is further challenged (IPCC, 2018).

2.4 The Challenge of Knowledge Management in Climate Change and Natural Hazard Risk Management

Knowledge is defined as, "the result of merging information with practice, perspective, and expression, resulting in insinuation and presents approaches and plans on which decisions are based on" (Karadsheh et al., 2009, p. 68). When producing knowledge, Karadsheh et al. (2009) suggest that knowledge producers should ask themselves this question: "*how can this information be used?"* While the act of producing knowledge is valuable, not all knowledge produced is useful to everyone (Karadsheh et al., 2009). Knowledge sharing is specifically defined as: "the flow of knowledge among individuals" (Karadsheh et al., 2009, p. 76). Knowledge sharing is a term that is used interchangeably with other terms such as knowledge exchange, knowledge transmission, or knowledge mobilization (*Figure 7*) (Cvitanovic et al., 2015; Cvitanovic et al., 2016; Fazey et al., 2012; Nguyen et al., 2017; Reed et al., 2014; Roux et al., 2006).

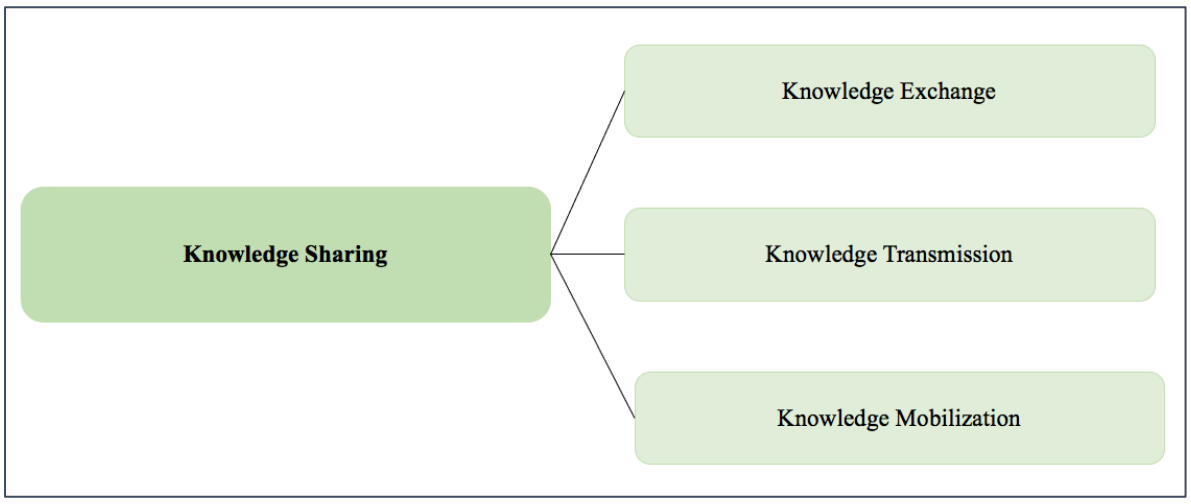

Figure 7 Alternative Terms to Reference Knowledge Sharing

While each of these terms possess their own definition, each definition alludes to the sharing of knowledge. Knowledge management possesses various definitions, displayed in *Table 6*; however, at the core of each definition is: the efficient handling of information.

Table 6 Knowledge Management Definitions (Alhawari et al., 2012, p. 52)

Knowledge Management Definitions	
Alavi & Leidner, 1999	• an organized and systemic process for acquiring, organizing and exchanging knowledge among employees to effectively utilize knowledge

Holsapple & Joshi, 2004	• an entity's systematic and deliberate efforts to expand, cultivate, and apply available knowledge in ways that add value to the entity, in the sense of positive outcome in achievement its objectives or fulfilling its purpose
Kim, Lim, & Mitchell, 2004	• the methodical means of administrating this valuable resource, by promoting an incorporated approach to identifying, capturing, structuring, organizing, retrieving, sharing, and evaluating an enterprise's knowledge assets
Goh, 2005	• a methodical leveraging of data, information, proficiency and different structures of assets and resources to enhance organizational innovation, reaction, efficiency and capability
Marin-Garcia & Zarate Martínez, 2007	• an art of transforming information and intellectual assets to a permanent value for the organization, its partners and clients
Alryalat & Alhawari, 2008	• a procedure, process, or practice to accomplish the process about knowledge, process for knowledge and process from knowledge, which leads to an improvement in the internal and external operation

Karadsheh et al. (2009) created a theoretical framework for knowledge management (*Figure 8*). They suggest that the steps to effective knowledge sharing should emulate the following sequence: 1) establish adequate knowledge infrastructure; 2) understand the knowledge; 3) combine the knowledge; 4) evaluate the knowledge; 5) understand the knowledge broadly; 6) filter the knowledge; and; and 7) place knowledge in a repository (Karadsheh et al., 2009). Concerning the "knowledge repository" step in Karadsheh et al's (2009) *Framework*, the literature suggests knowledge brokerage as one potential means of managing knowledge to ensure the long-term success of knowledge sharing (Cvitanovic et al., 2015; Cvitanovic et al., 2016; Fazey et al., 2012; Raymond et al., 2010; Reed et al., 2014; Von Krogh et al., 2001). Knowledge brokers aid in the updating and organizing of past and present knowledge. Within each field, the management and sharing of knowledge is a uniquely tailored process. The management and sharing of knowledge within the fields of geography, environmental science, and environmental studies requires knowledge to be transferred between scientists, policy makers, operations officials, in addition to the general public (Arlettaz et al., 2010; Cvitanovic et al., 2016; Fazey et al., 2012; Gibbons et al., 2011; Nguyen et al., 2017; Raymond et al., 2010).

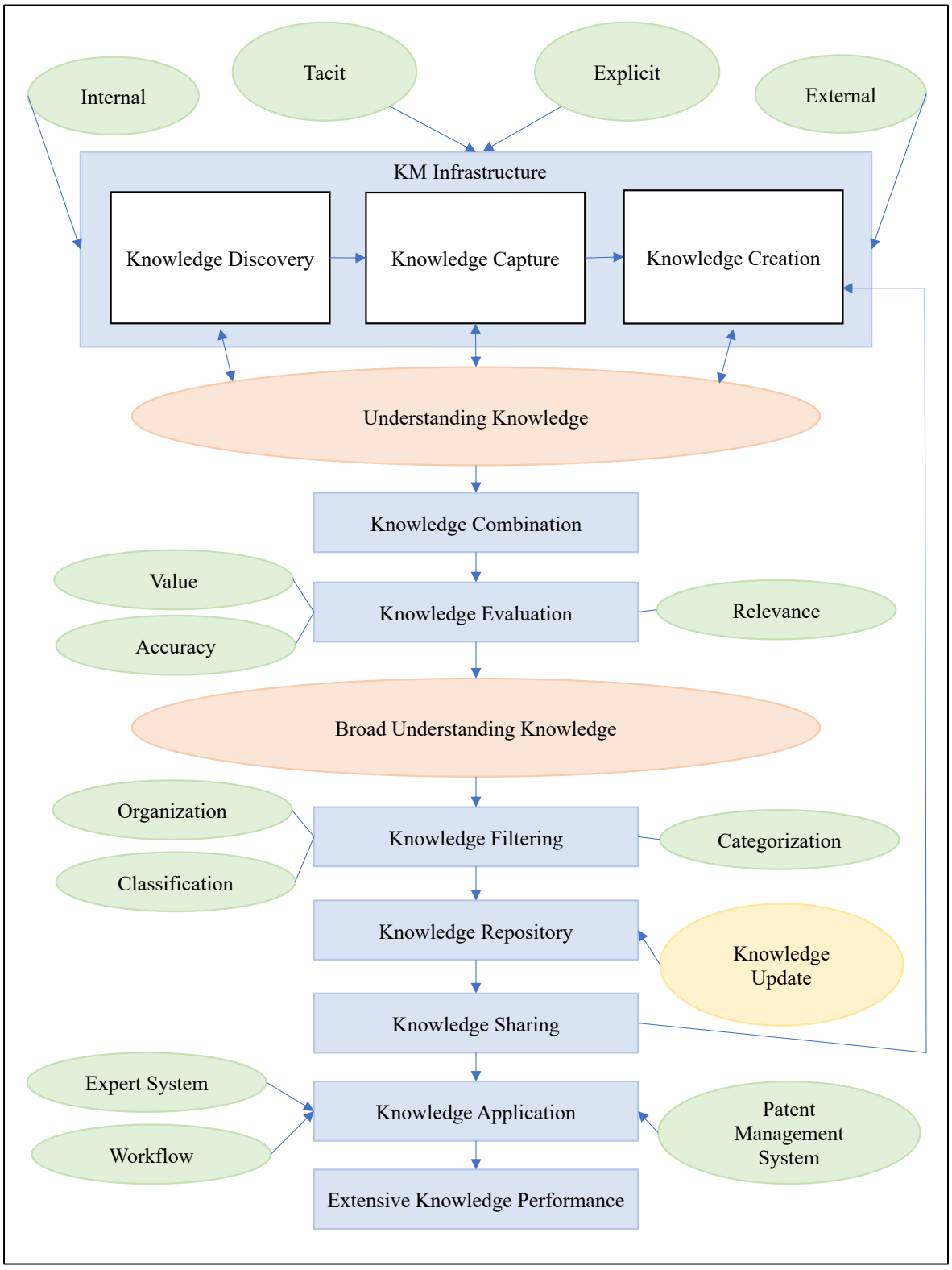

Figure 8 Theoretical Framework for Knowledge Management (Karadsheh et al., 2009, p. 75)

Accessibility of knowledge is a challenge faced when managing climate change and natural hazard risk management knowledge. The level at which knowledge is accessible determines its shareable quality.

In recent years, there has been a particular interest in the sharing of knowledge related to risk management, although the literature overall is underdeveloped in this area: "a growing body of research has examined the risk management process, but further research is needed to better understand the message content that lay individuals and experts use to frame and discuss risks" (Palenchar et al., 2002, p. 128). Indeed, for knowledge to serve its intended purpose, it should be accessible. Information should be highly accessible to an array of different audiences (Arlettaz et al., 2010; Cvitanovic et al., 2015; Roux et al., 2006). The ability for scientists to express their findings to lay audiences is critical to aid knowledge sharing. The literature has specifically indicated that the sharing of knowledge is a poorly executed exercise (Arlettaz et al., 2010). Knowledge should be disseminated to audiences who can put the newly discovered knowledge into practice. For example, the constant publication of articles by the academic community at times fails to place emphasis on the actual implementation and integration of newly produced knowledge into the practical world (Lemieux et al., 2018). Thus, this knowledge is not being effectively accessed or incorporated by those responsible for making climate change and natural hazard risk management decisions. *Figure 9* illustrates what is referred to as the 'research-implementation gap' where researchers produce knowledge that is not being accessed by policy makers.

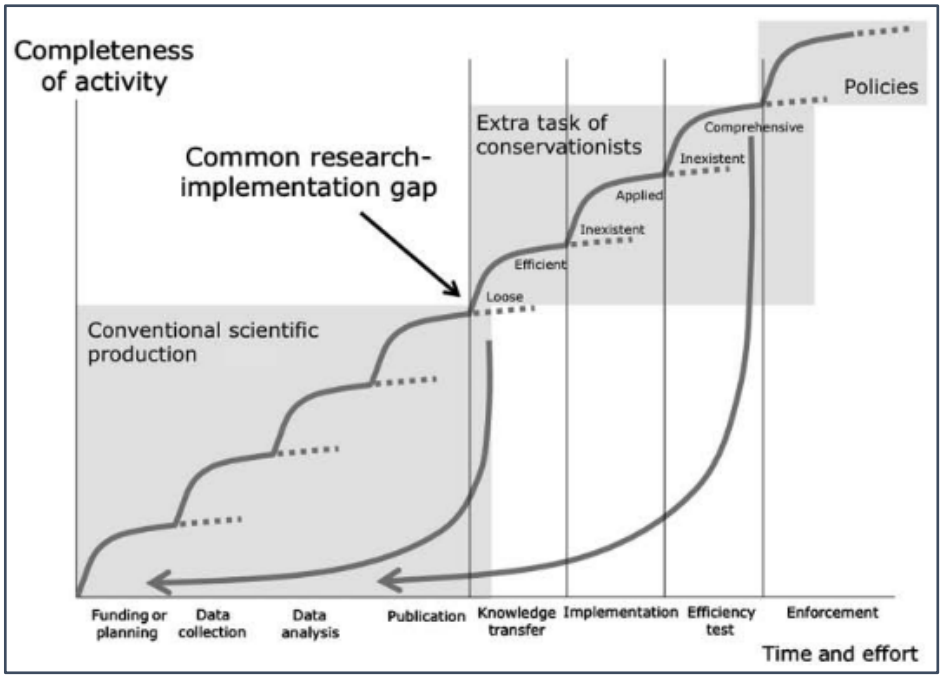

Figure 9 The Research Implementation Gap (Arlettaz et al., 2010, p. 840)

The research produced by scientists (*bottom, left corner*) is not reaching policy-makers (*top, right corner*). Consequently, the decisions being made by policy makers are failing to reflect recent

advancements in research. This disconnect negatively affects all those involved (Arlettaz et al., 2010; Cvitanovic et al., 2016; Fazey et al., 2012; Gibbons et al., 2011; Nguyen et al., 2017; Raymond et al., 2010). Decision-makers and others have indicated that having a vault of knowledge often does not serve a practical purpose. While scientific knowledge is actively produced, its ability to be translated to decision-makers and other stakeholders for practical use, presents as a great challenge (Lemieux et al., 2018). While the production of knowledge is a vital and necessary exercise, the sharing of knowledge produced is argued to be equally as important (Arlettaz et al., 2010; Cvitanovic et al., 2015; Cvitanovic et al., 2016; Fazey et al., 2012; Gibbons et al., 2011; Nguyen et al., 2017; Roux et al., 2006; Reed et al., 2014).

The mode that is selected to deliver and share climate change and natural hazard risk management knowledge is another knowledge management challenge. The Ontario Government produced the *Hazard Identification and Risk Assessment (HIRA)* document which: *"*attempts to assist emergency managers to better improve public safety and to protect against property and infrastructure damage by providing a tool that can be used to assess the consequences and frequency of hazards" (Emergency Management Ontario MCSCS, 2012, p. 11). Additionally, the Ontario Government produced the document, *Understanding Natural Hazards*, to aid provincial ministries concerning hazard related information (Dotto et al., 2010; Government of Ontario, 2001). While such detailed documents hold critical knowledge, they need to be readily accessible and referenced to serve their practical purpose. While knowledge pertaining to risk management is commonly shared in written documents, research suggests that the most effective mode for delivering complex knowledge is through visual format (Bennett et al., 2016; Peters et al., 2008). It has been recommended that by converting document-bound knowledge pertaining to climate change and natural hazard risk management into a more visual presentation format, the accessibility of past and current knowledge will be increased and, thus, the shareable quality of climate change and natural hazard risk management knowledge will be heightened (Peters et al., 2008). Peters et al. (2018) graph, in *Figure 10*, depicts the various modes through which climate science data is delivered to its practical users. The 11 modes include: "maps, visual data summaries, written data summaries, peer-review literature, technical reports, policy recommendations, case studies/stories, videos/slideshows, computer simulations, orally summarized data, and raw data" (Peters et al., 2018, p. 251).

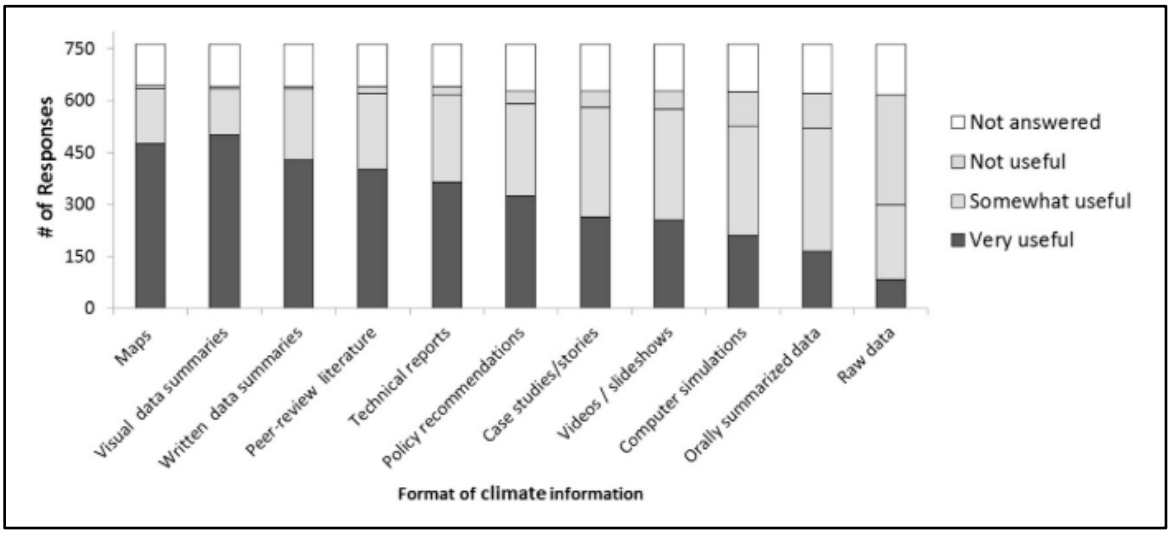

Figure 10 Receiving Climate Science: Different Formats (Peters et al., 2018, p. 252)

Visual data summaries, according to the graph's results, were determined to be a "very useful" way to deliver science data to practical users. Knowledge management, climate change and natural hazard risk management, are all highly complex concepts; moreover, by presenting visual versions of information, the most important information is easy to decipher and highly accessible to all.

Saunders et al. (2017) specifically explored the benefits of presenting safety messaging in a visual format. Visual safety messaging is one of the ways to best share natural hazard risk management; "safety messages can be absorbed quickly if a visual demonstration of the hazard is included" (Saunders et al., 2017, p. 5). If knowledge of natural hazard risk management were presented in a visual format, research suggests that the accessible and sharable quality of the knowledge would increase significantly. Time and resources are some of the challenges faced when managing climate change and natural hazard risk management knowledge. Extracting knowledge from documents requires great investments of time and resources by the reader; time and resources which readers, such as park management and operations officials, do not have. Summaries, PowerPoints, and factsheets are all examples of ways in which documents can be repackaged to increase knowledge-accessibility by park management officials.

Finally, a lack of knowledge is another challenge faced when managing climate change and natural hazard risk management knowledge. Climate change possesses the potential to increase natural hazard risk's occurrence and severity (Balluz et al., 2000; Hoekstra et al., 2010). Tornados and wind-events are natural hazard events that possess the potential to increase in occurrence and severity as a result of climate change; yet, knowledge pertaining to such natural hazard events is limited. High winds that are

characteristic of natural tornado hazard events result in hazard trees post-natural hazard occurrences, which needs to be immediately addressed to ensure safety (Baron et al., 2012). Limited literature was available to suggest how hazard trees should be addressed (National Park Service, 2008). Overall, in the face of climate change, all stakeholders with a role in natural hazard risk management should prioritize the use, production, sharing and management, of knowledge pertaining to natural hazard events, specifically tornadoes and wind-events.

Upon thorough review of the literature it was concluded that: knowledge sharing, knowledge management, risk management, climate change, natural hazards, and parks and protected areas, are topics which have all been researched in isolation, or researched by comparing only two of the six topics. The body of literature, to varying degrees, has focused on couplings, such as knowledge sharing of risk management (e.g. Alhawari et al., 2012; Haltiwanger et al., 2010; White et al., 2001), risk management of natural hazards (e.g. Ayyub et al., 2007; Djalante et al., 2011; Eiser et al, 2012), risk management in parks and protected areas (e.g. Becken & Hay, 2007; Eagles et al., 2002; Gstaettner et al., 2018; Gstaettner et al., 2020), climate change in parks and protected areas (Baron et al., 2009; Lemieux et al., 2011; Peters et al., 2018; Suffling & Scott 2002; Weber et al., 2019), and natural hazards in parks and protected areas (e.g. Dotto et al., 2010). Collectively, knowledge management and sharing of natural hazard risk management specifically in relation to parks and protected areas is an area of research that has been relatively unexplored. As stated above, the literature has identified many gaps, which promote opportunities for further research; however, the research gap believed to be the most in need of immediate investigation is research that focuses on combining knowledge management and sharing of natural hazard risk management in Canada's parks and protected areas in the face of climate change.

2.4.1 Adaptation, Adaptive Capacity and Governance

Concepts such as adaptation, adaptive capacity, governance and adaptive governance are frequently referenced in the climate change literature. Climate change will challenge traditional natural hazard plans, management, and responses; moreover, the success of climate change planning, management, or responses is greatly dependant on an organization's or individual's capacity to plan and manage for climate change adaptatively and in good governance.

The IPCC (2018) defines adaptation in human systems as:

> the process of adjustment to actual or expected climate and its effects, in order to moderate harm or exploit beneficial opportunities. In natural systems, the process of adjustment to actual climate and its effects; human intervention may facilitate adjustment to expected climate and its effects. (p. 542)

Adaptation is a: "problem-solving process, whereby priority is given to communication, perspective sharing, social learning, negotiation, and the development of adaptive collaborative strategies for moving forward" (p. 6). A related term, adaptive capacity, is defined as: "the ability of systems, institutions, humans and other organisms to adjust to potential damage, to take advantage of opportunities, or to respond to consequences" (IPCC, 2018, p. 542). There are various factors that determine an organization's adaptive capacity, such as money, time, staff, and training. Climate change possesses the potential to increase the occurrence and severity of such natural hazard risks. Moreover, it is anticipated that an organization's need to adapt will be heightened and the adaptive capacities of organizations will, overall, be challenged.

Governance is important because it is a system and process concerned with directing and controlling an entity's structures and processes (United Nations, 2021). Governance is defined by Folke et al. (2005), as: "the structures and processes by which people in societies make decisions and share power" (p. 444). The public sector, private sector, local governments, academia, and civil society are only some of the stakeholders involved in making climate-related decisions. The United Nations identified eight good governance characteristics. The United Nations indicated that good governance is: 1) participatory, 2) consensus oriented, 3) accountable, 4) transparent, 5) responsive, 6) effective and efficient, 7) equitable and inclusive and 8) follows the rule of law (United Nations, 2016). Aligning with the United Nations eight good governance characteristics, Djalante et al. (2011) states that: "governing for climate change requires the provision of an open, deliberative space for local stakeholders" (p. 5). Good governance is responsive to the present and future needs of society (United Nations, 2016) and will require good governance and adaptive governance in order to combat climate change (Berkes, 2017).

Adaptive governance is:

> an emerging term in the literature for the evolution of formal and informal institutions of governance that prioritize social learning in planning, implementation and evaluation of policy through iterative social learning to steer the use and protection of natural resources,

> ecosystem services and common pool natural resources, particularly in situations of complexity and uncertainty. (IPCC, 2018, p. 550)

Berkes (2017) states that adaptive governance is: "about ongoing processes, not a search for some optimal solution to one problem" (p. 6). Djalante et al. (2011) specifically discussed four characteristics of adaptive governance, that are important to help increase resilience to natural hazards. These characteristics include polycentric and multilayered institutions, participation and collaboration, self-organization and networks, and learning and innovation (Djalante et al., 2011). *Figure 11* provides a general understanding of each characteristic and visually displays the interlinkages between: polycentric and multilayered institutions, participation and collaboration, self-organization and networks, and learning and innovation. These four characteristics of adaptive governance, help to build resilience to natural hazards (Djalante et al., 2011).

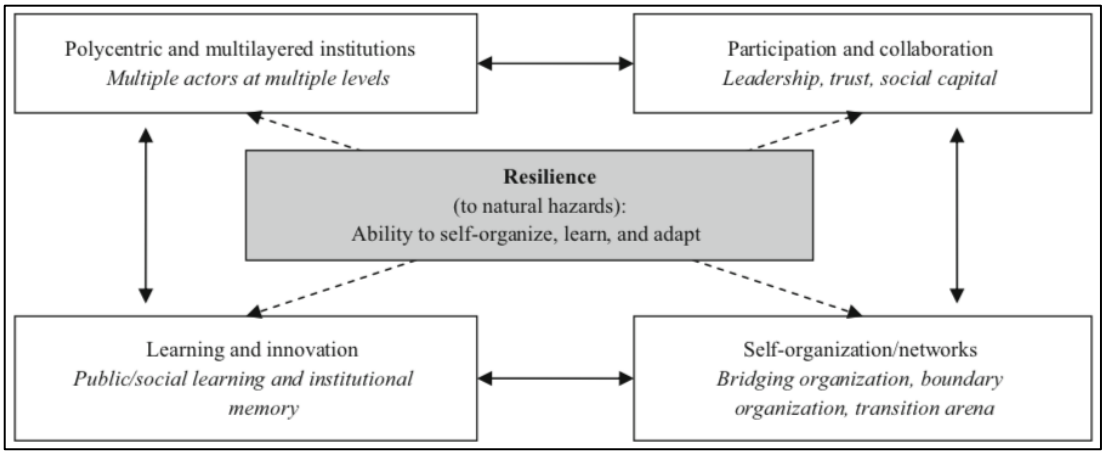

Figure 11 Interlinkages Between Key Characteristics of Adaptive Governance in Relation to Building Resilience (Djalante et al., 2011, p. 4)

Djalante et al. (2011) emphasised that: "building the resilience of communities and societies to natural hazards and climate change impacts is not just an outcome, but also a long and challenging process" (p. 13).

Additionally, Berkes (2017) proposed a three-point argument to operationalizing adaptive governance:

> (1) people and environment need to be considered together as social-ecological systems used as the unit of analysis; (2) resilience, which deals with change in multilevel complex systems, is appropriate for the analysis of scale issues and the adaptive in adaptive

> governance; and (3) there is a need to foster collaborative approaches to improve learning for adaptive governance. (p. 8)

As climate change continues to challenge parks and protected area's management, adaptation in all areas will become ever more important.

2.4.2 The Importance of Knowledge Management in Enhancing Adaptive Capacity to Respond to Emerging Natural Hazard Risk Management Issues

Knowledge management is an important variable when considering the adaptive capacity to respond to emerging natural hazard risk management issues. In some respects, and in the spirit of adaptive management, knowledge management is a never-ending endeavor, as each new risk poses a need to create or update knowledge, which in turn should be shared among the necessary at-risk stakeholders. Haltiwanger et al. (2010) illustrates that by initially managing knowledge, risk is mitigated as a result (*Figure 12*).

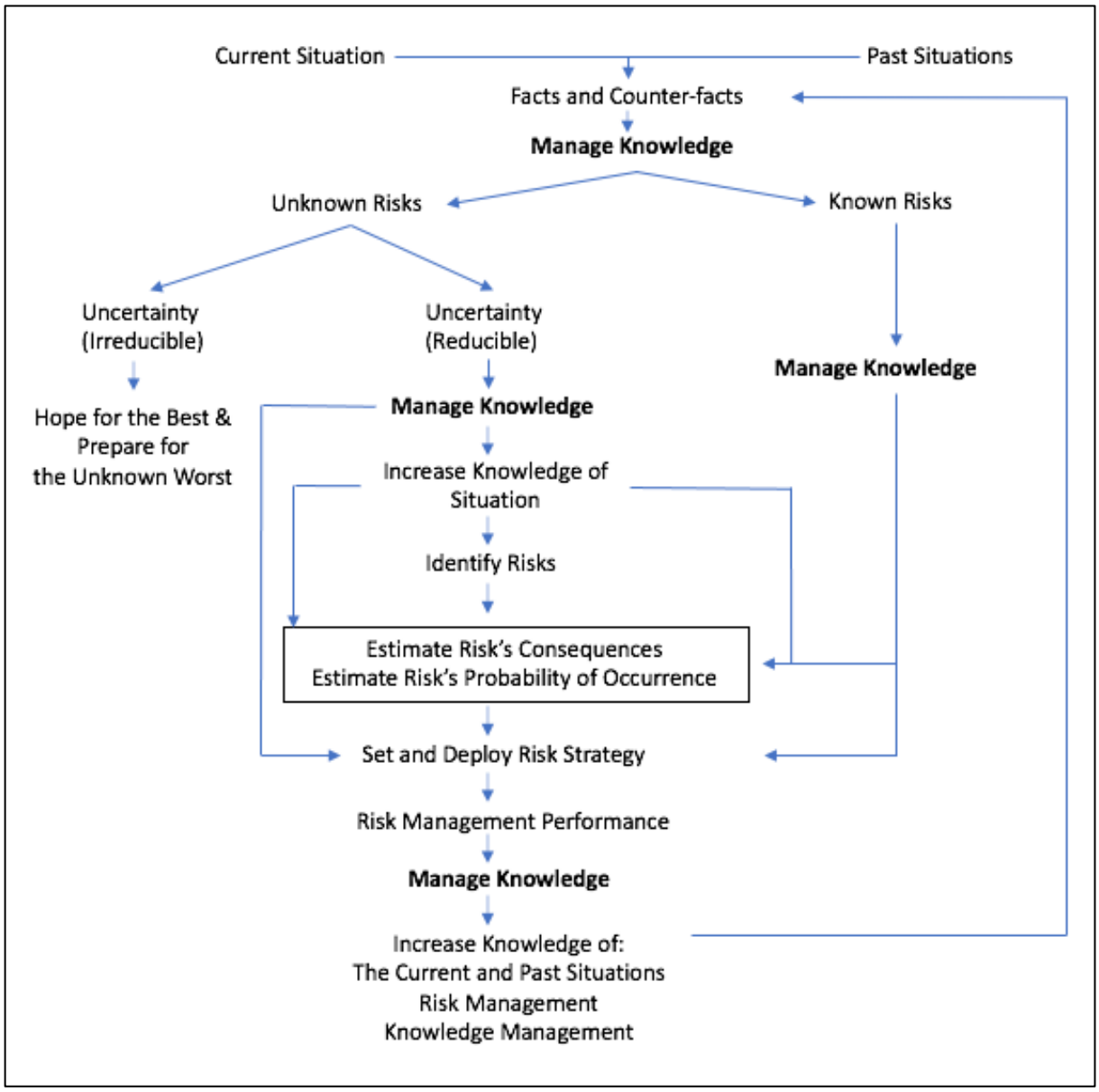

Figure 12 Knowledge and Risk Management Conceptual Model (Haltiwanger et al., 2010, p. 288)

The increasing occurrence of natural hazards, combined with a potential future increase in occurrence of natural hazard events, underscores the need for more effective knowledge management related to natural hazards (Klein et al., 2011; Olson et al., 2017; White et al., 2001). However, managing the risks associated with natural hazards is not a simple task. Any and all knowledge acquired pertaining to natural hazard risk management should be readily managed because natural hazards are environmental processes largely influenced by climate that do not respect municipal or political boundaries; natural hazards are best planned and managed for by using an integrated approach (Government of Ontario, 2001).

Figure 13 visually displays a framework created by the National Park Service. The *Framework* is intended to aid collaborative adaptation planning; however, this *Framework* could be repurposed to serve as a framework to facilitate knowledge management that enhances adaptive capacity to respond to and reflect on emerging natural hazard risk events, as illustrated in *Figure 14.* For example: "Natural Hazard (e.g., Tornado/Wind-event)" would be the "Issue," that is being framed. Then a "Science/Knowledge Assessment" would need to be completed focusing on the selected "Natural Hazard." A "Scenario Development/Risk Assessment" would occur next, focusing specifically on the selected "Natural Hazard." An "Action Plan/Implement" would then be required. To fully employ the *Framework* one would "Track Key Indicators, Evaluate Progress and Unintended Consequences" for the "Natural Hazard/Issue (e.g. Tornado/Wind-event)" subjected to the *Framework*. If each natural hazard listed in *Figure 5* was subjected to this *Framework*, knowledge management, that enhances adaptive capacity to respond to and reflect on emerging natural hazard risk events, would benefit.

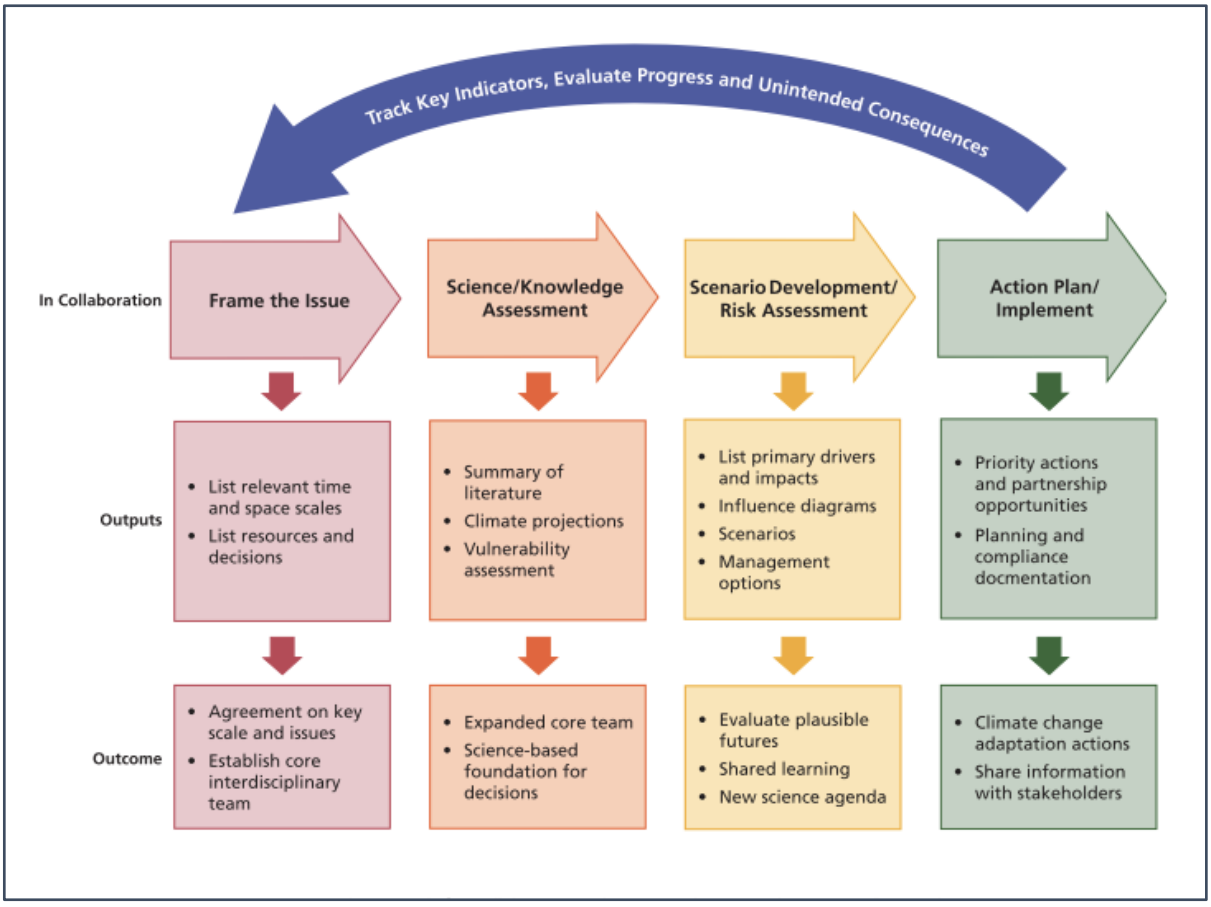

Figure 13 Conceptual Framework for Collaborative Adaptation Planning (National Park Service, 2010, p. 16)

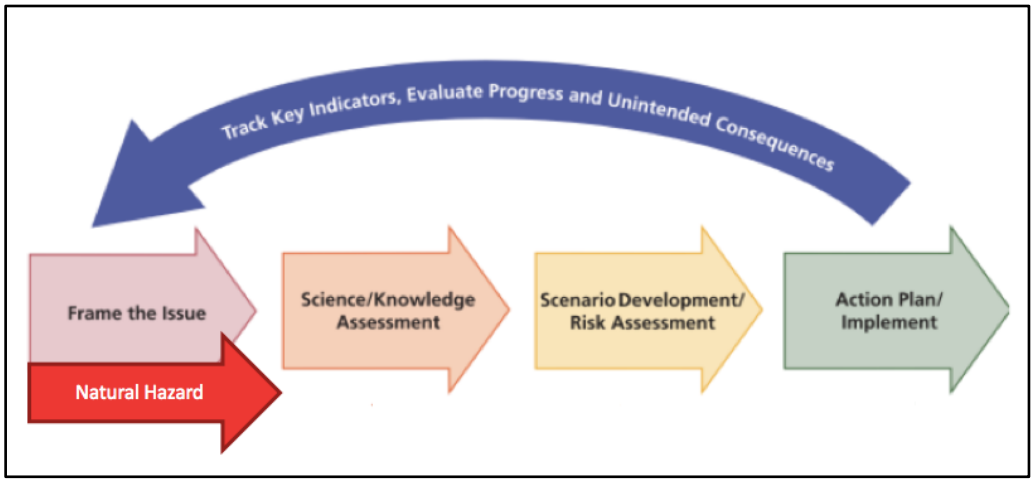

Figure 14 Framework for Knowledge Management that Enhances Adaptive Capacity to Respond to and Reflect on Emerging Natural Hazard Risk Events (National Park Service, 2010, p. 16)

In recent years, there has been an increased emphasis on the access and sharing of different forms of knowledge (Arlettaz et al., 2010; Bennett et al., 2016; Cvitanovic et al., 2016; Djalante et al., 2015; Fazey et al., 2012; Gibbons et al., 2011; Lemieux et al., 2018; Nguyen et al., 2017; Raymond et al., 2010; Reed et al., 2014). Natural science (scientific knowledge), social science, and traditional ecological knowledge, Indigenous knowledge, and other forms of local knowledge are some of the different forms of knowledge. Natural science is the form of knowledge that has traditionally been most frequently accessed and shared (Bennett et al., 2016). Managing knowledge in a way that equally encourages the access and sharing of natural science knowledge, social science knowledge, and traditional ecological knowledge, Indigenous knowledge and other forms of local knowledge, would promote good governance and enhance adaptive capacity to respond to emerging natural hazard risk management issues.

Parks and protected areas are significant entities within their respective regions and characteristically organized by multiple levels of management. The management of natural hazard risk management knowledge is essential to enhancing the adaptive capacity of parks and protected areas organizations and the greater regions in which they are located. Parks and protected areas are subject to natural processes, which include natural hazards. As Saunders (2017) notes: “park managers have a legal duty to take reasonable care to avoid foreseeable risks of injury, and to inform visitors about hazards, particularly where they are not obvious” (p. 6). With climate change, natural hazards are expected to increase in occurrence and severity; furthermore, adaptive capacity, supported by effective knowledge

management, will become ever more important (Baron et al., 2009; Lemieux et al., 2011; Suffling & Scott, 2002).

Tornadoes and wind-events are natural hazard risks that require parks and protected areas to manage knowledge in a way that enhances adaptive capacity. Tornadoes can both cause grave destruction to the landscape and claim the lives of individuals who are inadequately prepared for such events (Balluz et al., 2000; Dotto et al., 2010). The onset of tornado activity occurs quickly resulting in minimal time for unorganized response (Balluz et al., 2000). The literature referenced discussed that a population's response to such natural tornado hazard events is considered to be highly variable (Balluz et al., 2000).

To mitigate the impacts of natural hazard events, individuals should effectively manage and share natural hazard risk management knowledge, specific to tornadoes, to compose the optimal response to such natural hazard events (Emergency Management Ontario MCSCS, 2012; Government of Ontario, 2001; Public Safety Canada, 2011). The management and sharing of natural hazard risk management knowledge should occur before and after a tornado event. After every natural hazard, it is strongly suggested that time be scheduled to reflect on the management successes and failures as "this reflection can be a valuable learning experience by illuminating risk management elements that are outdated, ineffective, or inappropriate" (Rice & Spence, 2016, p. 614). The literature emphasized the fact that every natural hazard is different. The management and sharing of natural hazard risk management knowledge is a timely necessity (Balluz et al., 2000; Hoekstra et al., 2010). A park or protected area's ability to optimally endure natural hazard events, such as tornadoes and wind-events, is directly correlated to their organization's adaptive capacity.

There is limited research pertaining to how knowledge of natural hazard risk management is being managed within Ontario's parks and protected areas. The body of research specific to Ontario Parks' efforts towards natural hazard risk management knowledge management is inadequate when compared to the increased occurrence and severity of natural hazard events and the high numbers of visitors in Ontario's provincial parks (Jones & Scott, 2006; Ministry of Natural Resources and Forestry, 2002; Mulrooney, 2003; Ontario Parks, 2012). It is important that Ontario Parks encourages research that distinctly addresses the management of natural hazard risk management knowledge, in order to enhance their adaptive capacity to climate change and natural hazard risks.

Chapter 3: Objectives

In light of challenges above, the objectives of the thesis are as follows:

1. Assess the current capacity of stakeholders responsible for risk management in the greater Pinery Provincial Park region to respond to wind-related natural hazards

2. Understand how different forms of knowledge (i.e., natural science, social science, traditional ecological knowledge, Indigenous knowledge, and other forms of local knowledge) are being used and shared amongst stakeholders with respect to wind-related natural hazard risk management in the region.

3. Provide recommendations to enhance collaboration and knowledge sharing related to wind-related natural hazard risk management in the greater Pinery Provincial Park region, with a focus on protecting the human health and safety of park visitors and all park staff

There are both scholarly and practical benefits associated with this research study. Through the use of a multi-stakeholder and case study approach, the findings of the research study can be used to academically advance a critical and understudied research gap related to natural hazard risk management in protected areas organizations. From a practical perspective, this research study will help foster long-term collaboration amongst stakeholders on risk management in the greater Pinery Provincial Park region. This collaboration that will be important now and even more so in the context of future climate change.

Chapter 4: Methods

4.1 The Greater Pinery Provincial Park Region

The research study was conducted in Ontario, Canada, and specifically in the greater Pinery Provincial Park region. The greater Pinery Provincial Park region is inclusive of Lambton County (*Figure 15*).

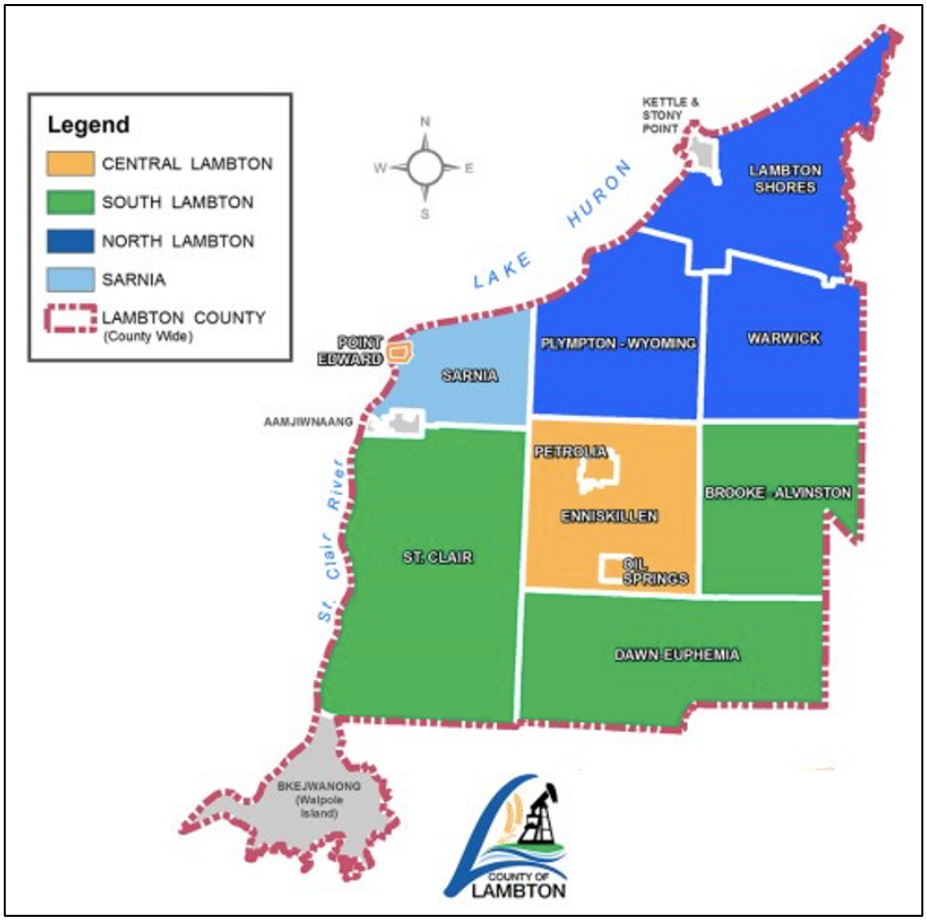

Figure 15 Lambton County and Municipality of Lambton Shores, Ontario, Canada (Lambton County, 2019)

Lambton County is comprised of eight municipalities. The northern-most municipality in Lambton County is the Municipality of Lambton Shores where Pinery Provincial Park is specifically located (*Figure 15*). Pinery Provincial Park is located on the southeast shore of Lake Huron, south of Grand Bend, Ontario, Canada (*Figure 15*). Established in 1957 and officially opened in 1959, Pinery Provincial Park is a 2532.5 hectare provincial park apart of the Ontario Parks system (The Friends of Pinery Park, 2021) (*Figure 16*). Ontario Parks was founded in 1954.

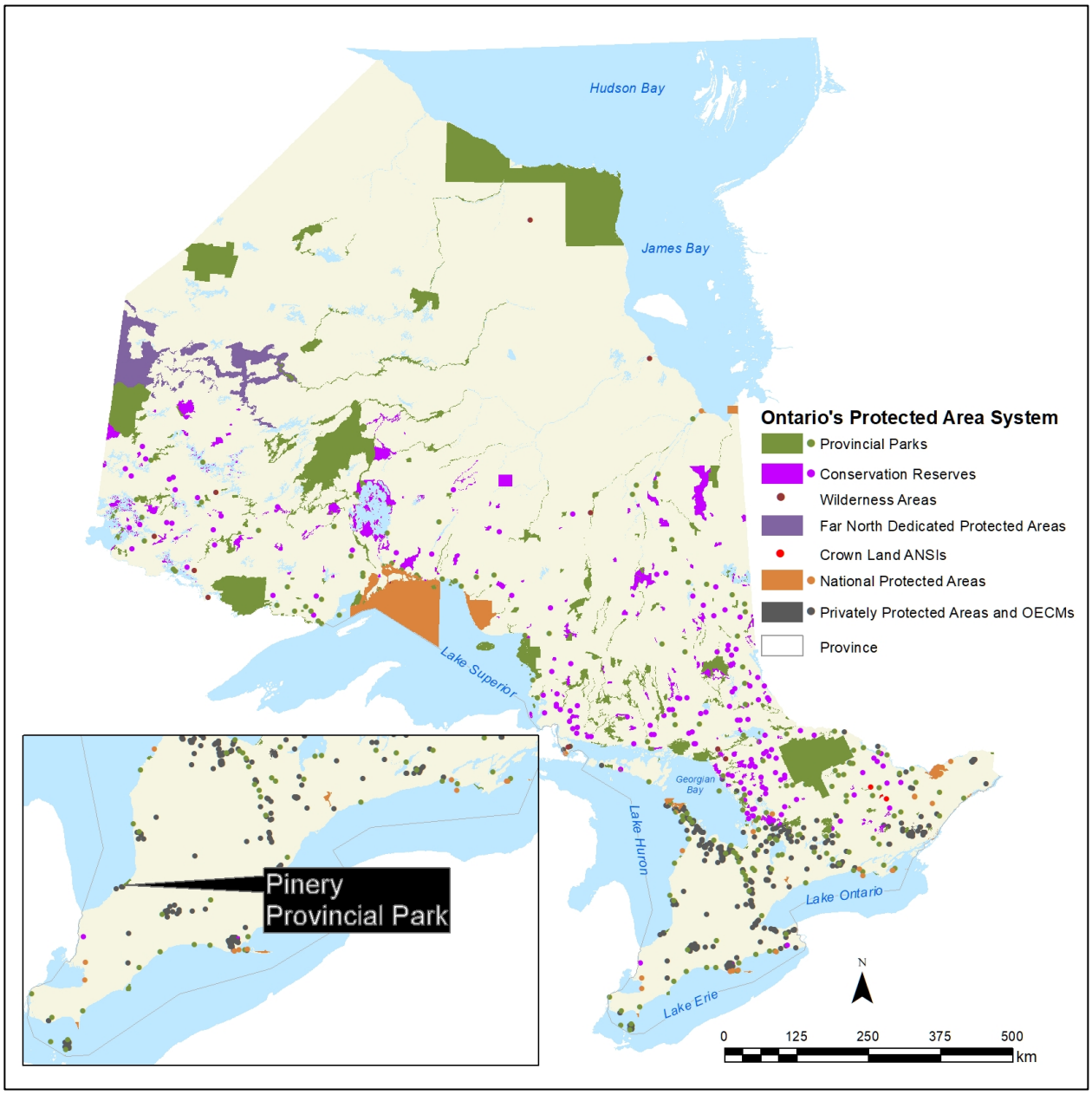

Figure 16 Ontario's Protected Area System: Pinery Provincial Park (Ontario Parks, personal communication, 2021)

Pinery Provincial Park is classified under the Ontario Provincial Parks System as a Natural Environment Park: "a park that protects outstanding recreational landscapes, representative ecosystems and provincially-significant elements of Ontario's natural and cultural heritage and provides high-quality recreational and educational experiences" (Ministry of the Environment, Conservation and Parks, 2021), and an IUCN Category II protected area: "a large natural or near natural area set aside to protect large-scale ecological processes, along with the complement of species and ecosystem characteristic of the area, which also provide a foundation for environmentally and culturally compatible spiritual, scientific,

recreational and visitor opportunities" (International Union for Conservation of Nature, 2021). Pinery Provincial Park represents several significant provincial and national features including a: globally rare oak savanna ecosystem, freshwater coastal dunes, and the largest protected forest in southwestern Ontario (Ontario Ministry of Natural Resources, 1986; The Friends of Pinery Park, 2021). Additionally, the Old Ausable Channel is a provincially significant wetland, that runs through Pinery Provincial Park (Ministry of the Environment, Conservation and Parks, 2021).

Figure 17 Pinery Provincial Park Map (The Friends of Pinery Park, 2021)

In both the summer and winter seasons of 2019, Pinery Provincial Park was the fourth most visited park within the Ontario Parks system (Ontario Parks, 2021). Welcoming approximately 600,000 visitors each year, Pinery Provincial Park supports excellent year-round recreation opportunities such as: camping, hiking, swimming, canoeing, fishing, cross-country skiing, and one of the largest year-round interpretative programs in Ontario (*Figure 17*) (Grand Bend & Area Chamber of Commerce, 2013; The Friends of Pinery Park, 2021).

4.2 Case Study Approach

The research study followed a case study approach. The case study area selected for the research study was the greater Pinery Provincial Park region and the units of analysis for the research study were stakeholders and organizations involved in risk management in the greater Pinery Provincial Park region. The research study was bound by time and place (Creswell, 2003). Recognizing the interconnectedness and complexity of the case study site, the research study was approached through qualitative methods, as such methods are ideal to explore topics where little is known and foster a deeper understanding of complex management problems (Blye et al., 2020). According to Yin (2003) a case study design should be considered when: the focus of the study is to answer "how" and "why" questions; one cannot manipulate the behaviour of those involved in the study; one wants to cover contextual conditions because it is believed they are relevant to the phenomenon under study; or the boundaries are not clear between the phenomenon and context (Baxter & Jack, 2008).

Case studies are an effective method when research is exploratory and seek to answer a question that can help explain the presumed causal links in real-life interventions that are too complex for the survey or experimental strategies (Baxter & Jack, 2008; Yin, 2003). Case studies are explanatory in nature and used to explore situations in which the intervention being evaluated has no clear, single set of outcomes. They are also descriptive, used to describe an intervention or phenomenon and the real-life context in which it occurred (Baxter & Jack, 2008; Yin, 2003). The comparative advantages of case study methods include: 1) identifying new or omitted variables and hypotheses; 2) examining intervening variables in individual cases to make inferences on which causal mechanisms may have been at work; 3) developing historical explanations of particular cases; 4) attaining high levels of construct validity; and, 5) using contingent generalizations to model complex relationships, such as path dependency and multiple interactions effects (Bennett, 2004).

The greater Pinery Provincial Park region provided an ideal and highly relevant location for a case study focused on exploring knowledge mobilization in the context of natural hazard risk management. A local provincial government key informant identified "wind-related events and tornadoes" to be of greatest timely relevance and importance to the provincial park and the greater park region (P.G.L.1, personal communication, May 2018). The greater Pinery Provincial Park region case study is also a part of a broader research study partnership that is focused on examining multiple knowledge mobilization case studies in different protected areas or protected areas regions across Canada (Carruthers Den Hoed et al., 2020). Relatedly, Yin (2003) explained that a multiple case study enables the researcher to explore

differences within and between cases. The goal is to replicate findings across cases. The evidence created from this type of study is considered robust and reliable, it can also be extremely time consuming and expensive to conduct (Yin, 2003). The greater Pinery Provincial Park region case study is one of five case studies a part of a Canada-wide research study focused on knowledge mobilization in protected areas. The four other case studies include: Bruce Peninsula National Park region, Beaver Hills Biosphere, Kananaskis Country, and Tofino. The research partnership includes, but is not limited to, park agencies and universities from across Canada (Blye et al., 2020).

Two permits were required to conduct this research study: a research permit from Ontario Parks and ethics approval from Wilfrid Laurier University. A letter of authorization to conduct research in a Provincial Park or Conservation Reserve was obtained from Ontario Parks on May 6, 2019. Ethics approval was obtained from the Research Ethics Board at Wilfrid Laurier University (REB # 6198) on July 29, 2019.

4.3 Research Design

Two frameworks informed the design of the research study: Nguyen et al.'s (2017) *Knowledge-Action Framework* and Bennett et al.'s (2016) *Framework for Collaborative and Integrated Conservation Science and Practice*. Nguyen et al.'s (2017) *Knowledge–Action Framework* (*Figure 18)*, is a dynamic framework to help build empirical evidence in an organized manner and further understanding of knowledge movement in the context of conservation and natural resource management. Nguyen et al. (2017) adapted three core elements to their proposed *Framework*: knowledge production or coproduction; the knowledge mediation sphere (i.e., the knowledge action gap); and the knowledge action outcome.

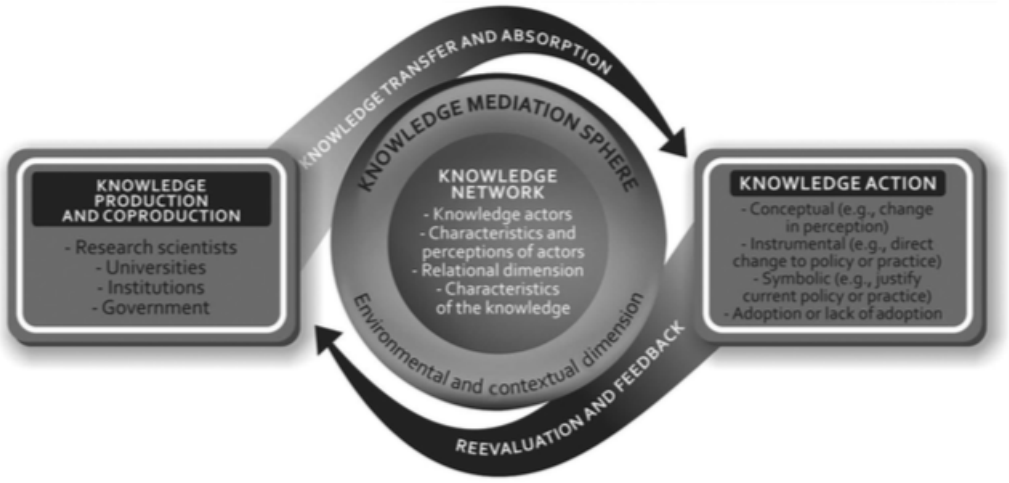

Figure 18 Nguyen et al.'s (2017) Knowledge–Action Framework (p. 791)

Additionally, Bennett et al.'s (2016) *Framework for Collaborative and Integrated Conservation Science and Practice* (*Figure 19*) provided practical guidance on overcoming ideological, institutional, knowledge, and capacity barriers, and to more effectively mainstream the social sciences in conservation science, practice, and policy.

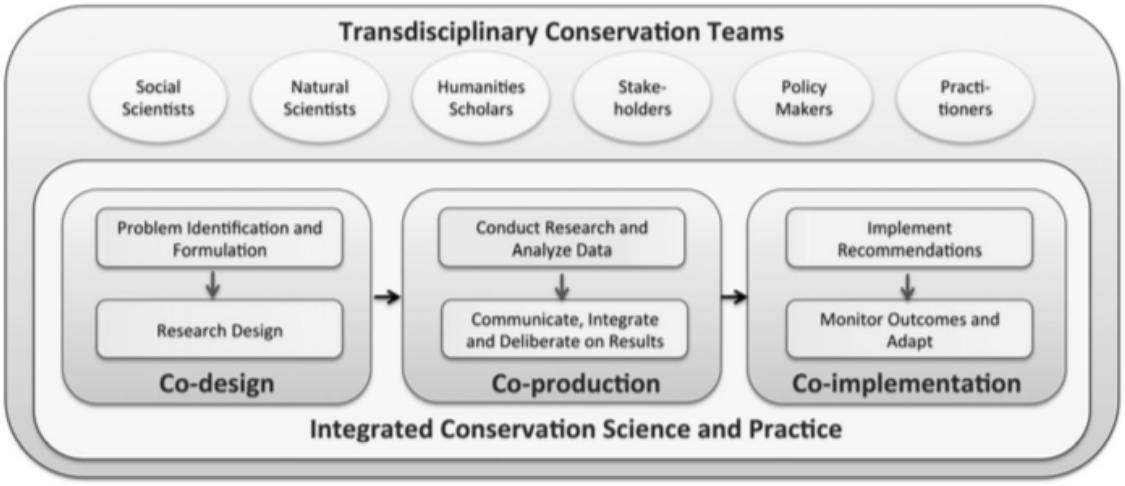

Figure 19 Bennett et al.'s (2016) Collaborative and Integrated Conservation Science and Practice Framework (p. 56)

This research study also employed a pragmatic research paradigm. Pragmatism, while relatively new to conservation literature, is a philosophy based on common sense, that simultaneously is dedicated to the transformation of culture, and to the resolution of the conflicts that divide philosophers and researchers alike. This philosophical worldview believes that in the single reality of the world with multiple perspectives and experiences of that reality, knowledge is therefore constructed and based on reality. Research questions are not inherently "important" and methods are not automatically "appropriate," rather researchers make the choices about what is important, and what is appropriate (Blye et al., 2020; Morgan, 2007; Sleeper, 1986).

4.4 Key Informants

This study followed a purposeful sampling approach as described by Creswell and Poth (2018), in which researchers selected individuals and sites as they can purposefully inform understanding of the research problem and central phenomenon of the research study. The key informants invited to participate in the research study were identified as having a main role in natural hazard risk management in the greater Pinery Provincial Park region. Key informants were initially identified by the researchers and the local provincial government key informant who identified the natural hazard risk of focus. The key informants were also asked to suggest any other individuals or organizations in the region that they felt would beneficially inform the research study, after completion of their in-person interviews.

Recognizing that there is no set criteria for sample size within qualitative research, 23 potential key informants across eight organizations were invited by means of email to participate in the research study (Blye et al., 2020). Of the 23 potential key informants, 15 accepted the request to participate in the research study. The key informant research response rate was 65%. However, it is important to note that the organization research response rate was 100%. That is, potential key informants from each of the eight organizations invited to participate in the research study were represented. Some organizations felt that they would be adequately represented by only one or two key informants.

The 15 key informants that participated in the research study were representative of the: provincial government (e.g. regional), provincial government (e.g. local); local government (e.g. regional), local government (e.g. municipal), public health sector (e.g. hospital & health care centre), and other conservation agencies (*Table 7*).

Table 7 15 Key Informants

Affiliation	*Coded Identity*	*N*
Provincial Government (Regional)	P.G.R.1 P.G.R.2	2
Provincial Government (Local)	P.G.L.1 P.G.L.2 P.G.L.3 P.G.L.4	4
Local Government (Regional)	L.G.R.1	1
Local Government (Municipal)	L.G.M.1 L.G.M.2	2
Public Health Sector (Hospital & Health Care Centre)	P.H.S.1 P.H.S.2 P.H.S.3 P.H.S.4	4
Other Conservation Agencies	O.C.A.1 O.C.A.2	2
		Total: 15

4.5 Research Team

The research team was composed of four researchers: Madeline McFadden, a Master of Environmental Studies candidate at Wilfrid Laurier University; Christopher Lemieux, a professor at Wilfrid Laurier University; Stephanie Barr, a post-doctoral fellow at Wilfrid Laurier University; and Catherine Reining, a recent graduate of the Master of Environmental Studies program at Wilfrid Laurier University.

4.6 In-Person Interviews

The in-person interviews were conducted over four months, with assistance from Stephanie Barr, from September 2019 to December 2019, and were the preferred method for data collection for several reasons. First, interviews can fill a gap in knowledge that other methods, such as observation or the use of census data, are unable to bridge efficaciously. Second, interviews allow the investigation of complex behaviours and motivations. Third, they are able collect a diversity of meaning, opinion and experiences, which provide insights into different opinions or debates within a group and can also reveal consensus on some issues. Finally, interviews show respect for and empower the key informants who provide the data, and interviews allow the researcher to discover what is relevant to the informant (Hay, 2016).

The in-person interviews followed a semi-structured interview form. This is a form of interviewing that has some degree of predetermined order but maintains flexible in the way issues are addressed by the key informant (Hay, 2016). The researchers were required to redirect the conversation if it moved too far

from the research topic (Hay, 2016). An interview schedule was prepared with 25 fully worded questions. 16 interview questions were unique to the case study; however, nine questions were selected from an interview schedule provided by the Canada-wide research study noted above. The nine questions selected from the Canada-wide research study interview schedule will allow for comparative analysis between all five case studies.

The in-person interviews ranged from 30 minutes to 1.5 hours, depending on the depth of each key informant's responses. In-person interviews were strategically scheduled so that the entire in-person interview could be completed in one day; moreover, time was allotted to allow the key informants to elaborate as much or as little as they preferred.

To incentivize the 15 key informants to participate in the in-person interviews, the researchers travelled to the key informants, and key informants were able to choose the location of their in-person interview. It was advised that the in-person interviews take place in a quiet, private location and to favour conditions that would provide clear audio recordings (e.g., personal office, conference room, etc…). The key informant's in-person interviews were conducted individually to allow for transparency and anonymity.

4.7 Data Preparation

4.7.1 Transcription

Upon completion of the key informant's in-person interviews, each in-person interview audio recording was transcribed. A verbatim transcription style: "the word-for-word reproduction of verbal data, where the written words are an exact replication of the audio recorded words" (Halcomb & Davidson, 2006, p. 38), was employed when transcribing the key informant's in-person interviews as it best catered to the research study's inductive, thematic coding approach.

4.7.2 NVivo File Creation

NVivo 12 was used to analyze the key informant interview transcripts. A new NVivo project was created. Key informant's in-person interview transcripts were individually imported into NVivo. As each key informant's in-person interview transcript was imported into NVivo, NVivo prompted the researcher to create a case. The cases were named using the key informant's coded identities (e.g., P.G.R.1, P.G.L.1, L.G.R.1., etc.). Each case holds all of the information related to each key informant. When a case is opened, all of the information coded to the case can be reviewed. Lastly, the researchers went

through each of the key informants' transcripts, coding all and only the key informants' responses to their respective cases. The NVivo file was formatted to enable comparative analysis. Once the NVivo file was formatted, data analysis began.

4.8 Data Analysis

Once the in-person interviews were transcribed and the NVivo file was formatted data analysis began. Thematic analysis is a method for identifying, analyzing, and reporting themes within data. It minimally organizes and describes the data set in rich detail. However, it goes further than this and interprets various aspects of the research topic (Blye et al., 2020; Boyatis, 1998).

Thematic analyses can take either an inductive, deductive, or abductive approach. The thematic analysis method for this research study followed an inductive approach to coding and development of themes, meaning that the themes identified are strongly linked to the data themselves (Nowell et al., 2017, p. 8; Patton, 2015). An inductive approach, *"*is a process of coding the data without trying to fit it into a pre-existing coding frame or the researcher's analytic preconceptions*"* (Nowell et al., 2017, p. 8). An inductive approach was specifically chosen when coding the data because, *"*this form of thematic analysis is data-driven*"* (Nowell et al., 2017, p. 8). It is important to note that while the themes are linked to the data, the themes, *"*may bear little relation to the specific questions that were asked of the key informants*"* (Nowell et al., 2017, p. 8). While a deductive approach "is driven by the researchers' theoretical or analytic interest and may provide a more detailed analysis of some aspect of the data*"* (Nowell et al., 2017, p. 8), this approach was not used because the approach tends to produce a less rich description of the overall data (Nowell et al., 2017). Finally, an abductive approach involves the use of both inductive and deductive approaches to thematically analyze the data, but was not used for the purposes of this research.

The inductive thematic analysis of the research study's data followed an adapted version of Braun and Clarke's (2006) *Six-Phase Thematic Analysis Approach*, illustrated in *Figure 20.* An adapted version of Braun and Clarke's (2006) thematic analysis approach was specifically chosen to analyze the research study's data as their approach offers an accessible and theoretically-flexible approach to analyzing qualitative data (Braun & Clarke, 2006).

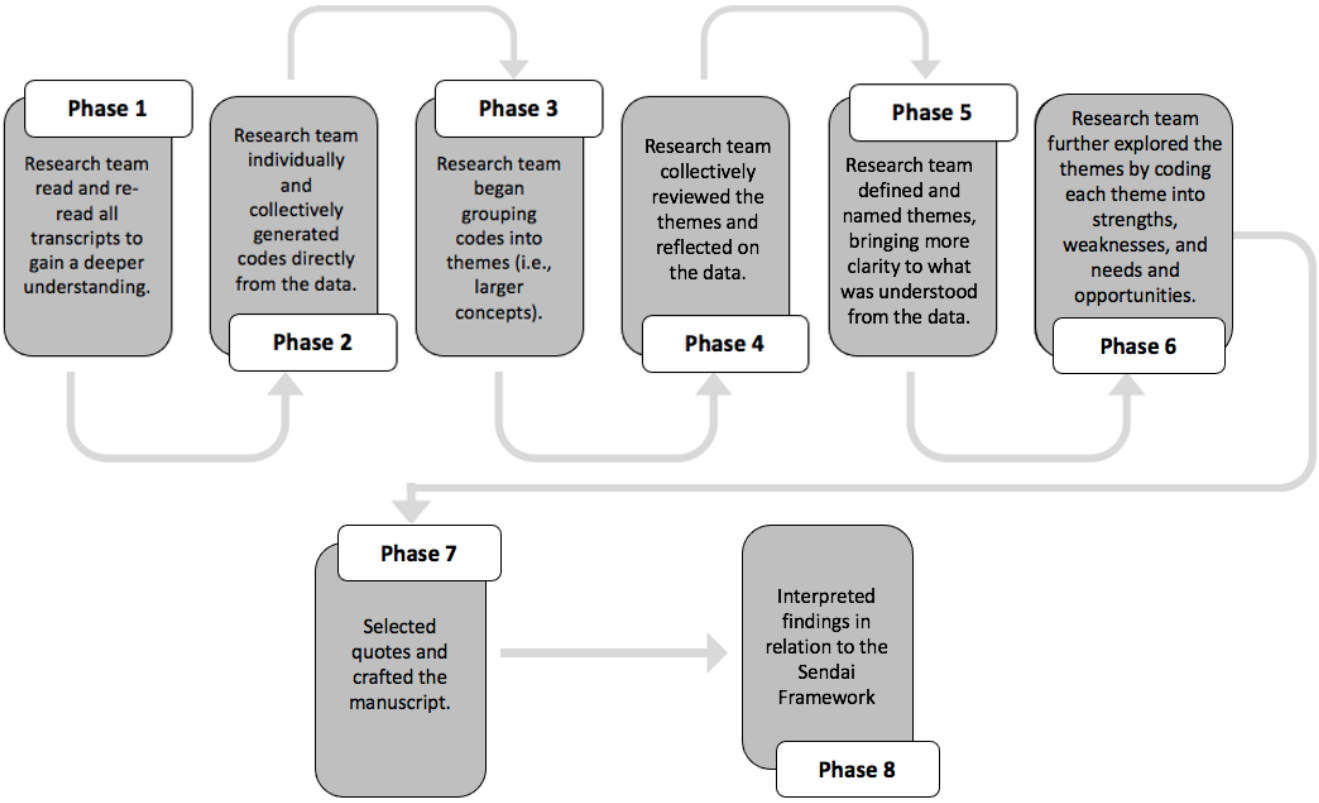

Figure 20 Adapted Version of Braun and Clarke's (2006) Six-Phase Thematic Analysis Approach

4.8.1 Phase 1

Phase one required the research team to read and re-read all 15 of the key informants' in-person interview transcripts in order to gain a comprehensive understanding of the data.

4.8.2 Phase 2

The research team both individually and collectively generated codes directly from the key informant in-person interview transcripts in phase two. The research team went back and forth, individually and collectively, generating codes four times (*Appendix C*). Each time the research team came together collectively, Madeline McFadden merged all four researcher's separate NVivo files together, to make a new master file.

4.8.3 Phase 3

From phases three to five, the research team only included Madeline McFadden, Christopher Lemieux, and Stephanie Barr. The research team began grouping codes into themes.

4.8.4 Phase 4

Phase four required the research team to collectively review the themes and reflect on the data. Phase four was repeated three times, and each time the research team came together collectively, Madeline McFadden merged all four researchers separate NVivo files together, to make a new master file (*Appendix C*).

4.8.5 Phase 5

In phase five, the research team named and defined the themes; furthermore, bringing more clarity to what is understood from the key informant's in-person interview transcripts (*Appendix C*). The 12 main themes, in addition to their definitions and descriptions, are summarized in *Table 8.*

Table 8 12 Main Themes

Theme		Theme Referred to Throughout the Thesis As	Definition	Description
1	Adaptive management allows for the continuous improvement of natural hazard risk management.	Adaptive Management	• "a process of iteratively planning, implementing, and modifying strategies for managing resources in the face of uncertainty and change" (IPCC, 2014, p. 1758)	• past natural hazard risk event examples • how individuals and organizations proactively "Build Back Better," from natural hazard risks • why it is ever more important to adaptively manage for natural hazard risks in an era of rapid climate change
2	Greater collaboration and partnership is needed to enhance natural hazard risk management.	Collaboration and Partnerships	• the act of working with someone for the benefit of a shared objective • the arrangement between two or more people to oversee something and share in its benefits	• what individuals and organizations collaborate and partner • how collaboration is and how partnerships are established and maintained between individuals and organizations • why individuals and organizations collaborate and partner
3	Enhancing natural hazard	Communication	• means of giving or receiving knowledge	• how knowledge, and specifically natural

	risk management requires greater communication.			hazard risk management knowledge, is communicated • what mediums are used to communicate such knowledge, internally or externally, between individuals and organizations
4	Acquiring all forms of knowledge leads to more robust natural hazard risk management.	Knowledge Acquisition	• how knowledge is obtained	• what, why and how individuals and organizations obtain knowledge
5	All forms of knowledge should be integrated into natural hazard risk management decision-making.	Knowledge Integration and Decision-making	• the act of processing or combining things in an effective way • the act of choosing	• why and how individuals and organizations process or combine various forms of knowledge (e.g. natural science, social science, traditional ecological, Indigenous, local) in an effective way to inform natural hazard risk management choices
6	Natural hazard risk management benefits when all forms of knowledge are shared and exchanged between all stakeholders.	Knowledge Sharing and Exchange	• the process by which knowledge is passed from one individual or organization to another	• who is sharing and exchanging knowledge • what knowledge is being shared and exchanged • why (or why not) knowledge is being shared and exchanged
7	Proactive planning is critical to successful natural hazard risk management.	Planning	• the process of outlining or developing an approach(es) to an anticipated event	• what individuals and organizations are involved in natural hazard risk management planning • what the natural hazard risk

				management planning process entails • how individuals and organizations go about proactively and reactively planning for natural hazard risks
8	Natural hazard risk management plans, policies, and regulations should be available and accessed.	Plans, Policies, and Regulations	• deliberate proposals, guidelines, or rules that exist to achieve, guide or control something	• what formal documents inform and mobilize natural hazard risk management
9	Productive relationships advantageously aid natural hazard risk management.	Relationships	• connections between two or more individuals or organizations	• what relationships do (or do not) exist • the formal and informal connections between individuals and organizations • how individuals and organizations regard and behave towards each other • how relationships are established and maintained
10	Availability of resources and capacity determine the success of natural hazard risk management.	Resources and Capacity	• the assets available to an individual or organization to allow for effective function • an individual's or organization's ability to do a certain thing	• what resources are (or are not) available • what the capacity of individuals or organizations are (or are not) • why resources and capacity are important to the success of natural hazard risk management
11	Natural hazard risk management is everyone's responsibility.	Responsibility	• the state of being accountable for something	• who is responsible for natural hazard risk management • how responsibility related to natural hazard risk

				management is determined • why it is important that all individuals and organizations take responsibility for natural hazard risk management
12	Natural hazard risk monitoring and evaluation informs management, especially in the face of climate change.	Risk Monitoring and Evaluation	• the act of observing and assessing something over a period of time	• how natural hazard risks have and can be monitored and evaluated • why it is ever more important to monitor and evaluate natural hazard risks in an era of rapid climate change

4.8.6 Phase 6

The research team further explored the themes by coding each theme into strengths, weaknesses, and needs and opportunities, in phase six.

4.8.7 Phase 7

In phase seven, Madeline McFadden selected illustrative quotes (*Appendix B.*) and began crafting the thesis document.

4.8.8 Phase 8

The findings were interpreted in relation to the *Sendai Framework for Disaster Risk Reduction 2015-2030*, in phase eight *(Chapter 6).*

Chapter 5: Results

5.1 12 Themes Identified from Interviews

Upon completion of the key informant's interviews, it was evident that saturation in terms of novel insights with respect to the research questions had been reached for the research study. The interviews with the key informants highlighted the use, production, sharing, and management of natural hazard risk management knowledge within the greater Pinery Provincial Park region. As noted above, the interviews yielded 12 main themes. As explained previously in Chapter 4, specifically phase seven of Braun and Clarke's (2006) adapted *Six-Phase Thematic Analysis Approach*, to explore these 12 themes in greater detail, each theme was coded further into strengths, weaknesses, and needs and opportunities.

5.1.1 Theme 1: Adaptive Management Allows for the Continuous Improvement of Natural Hazard Risk Management

Adaptive Management was one of the 12 themes identified when analyzing the key informants' interview transcripts. Adaptive management is: "a process of iteratively planning, implementing, and modifying strategies for managing resources in the face of uncertainty and change" (IPCC, 2014, p. 1758). The Adaptive Management theme focused on ideas such as: past natural hazard risk event examples, how individuals and organizations proactively "Build Back Better" from natural hazard risks, and why it is ever more important to adaptively manage for natural hazard risks in an era of rapid climate change. When coding *Table 9* provides a summary of the strengths, weaknesses, needs and opportunities identified and discussed by the key informants with respect to Adaptive Management.

Table 9 Theme 1: Summary of strengths, weaknesses, needs and opportunities for the Adaptive Management theme.

Theme 1: Adaptive Management
Strengths • Regional provincial government and local provincial government benefit from a cycle of continuous learning, supported by the large size of their organizations. • Local provincial government affiliated key informants reactively respond to natural hazard risks. • All key informants, with the exception of Public Health sector affiliated key informants, indicated that, when a natural hazard event occurs, discussions are had internally and externally. ***Weaknesses***

- The regional provincial government and local provincial government affiliated key informants highlighted the difficulty to plan for and manage the number and diversity of natural hazard risks.
- A municipal local government affiliated key informant found actioning adaptive management initiatives difficult.

Needs and Opportunities

- The regional provincial government and regional local government affiliated key informants emphasized the need to thoroughly understand natural hazard risks, as climate change possesses the potential to increase natural hazard risk's occurrence and severity.
- All key informants, with the exception of Public Health sector, identified a need to create and acquire more data and a need for more general information pertaining to natural hazard risks.
- The regional provincial government and local provincial government affiliated key informants expressed the need to proactively manage for natural hazard risks.
- All key informants expressed a need for the continuous improvement of natural hazard risk management in the region.

5.1.1.1 Strengths

Key informants identified various strengths related to the Adaptive Management theme. The regional provincial government and local provincial government affiliated key informants, confidently remarked that they advantageously benefit from the size of their organizations. For example, a regional provincial government affiliated key informant:

> *"we are such a large organization and operate across the province, we're in a cycle of continuous learning and improvement. So, areas where there might be an exacerbation of risk, would be a learning opportunity. And in that way, I think it really helps us to mitigate it in the future… always new events we recognize, and part of the training is that we don't rest on knowing that we've through something, so we know how to handle it. We just use that as a tool and then are expecting each part to have its, unique elements of it" (P.G.R.1).*

Due to the size of their organizations, regional provincial government and local provincial government affiliated key informants are in a state of continuous learning. While each of Ontario Parks' provincial parks have their own unique characteristics, these parks also share various commonalities. When a

natural hazard occurs in one park, the likelihood of a similar natural hazard occurring in another park is very probable. For example:

> "*we take measures of managing our liability to minimize the hazards within the park. Known hazards are to be/to be managed if they present, situations of injury or damage to property to the park users or to staff. So we/we're long established. We've been in this business for about 125 years, have approximately 200 parks. As an organization, we have experienced a lot of potential risks and hazards and have taken a lot of measures to mitigate it" (P.G.L.4)*.

Pinery Provincial Park adaptively manages for the natural hazard risks experienced in other Ontario Parks' provincial parks. Key informants, with the exception of Public Health sector affiliated key informants, were able to provide examples of adaptive management efforts. The 2011 tornado that touched down in Goderich, Ontario, was highlighted by two key informants as an event that influenced their adaptive management efforts:

> *"when Goderich had the, code orange and tornado, after they got themselves settled down, we then had webinar or with their staff, their/what was he- it was like a Site Director or a, Corporate Manager at that time. And just what went/learning the, learning the red flags, learning what happened, what went well, what didn't go well, what would you do differently next time, you know, what should we be looking out for? And that informed our code/'code orange' when we were working on it again" (P.H.S.2*), and:

> *"for example, not in the Pinery area, but Maitland Valley [Conservation Authority] had a tornado. The Goderich tornado went through there, Falls Reserve [Conservation Area] area. And, so after that happened, I was/I was chatting with the Superintendent and the staff and the supervisors about how they dealt with that. I know when the Durham tornado happened, the educators cause it was a child and an education day camp, that was killed during that event. And so the educators of the Conservation Authorities when they met, they discussed that, and how to deal with, situations like that" (O.C.A.1).*

All natural hazard risk events and natural hazard risk mitigative efforts should be discussed internally and externally to ensure strategic adaptive management.

5.1.1.2 Weaknesses

While many strengths were identified in relation to the Adaptive Management theme, weaknesses were also identified when analyzing the interview transcripts. The difficulty to plan for and manage every natural hazard risk was highlighted by both regional provincial government and local provincial government affiliated key informants. As a regional provincial government affiliated key informant stated: *"if something happens and you say, 'Yeah, there's not much I could've done about that.' But the reality is there's not much you can do about a lot of stuff. No matter how prepared you are and reasonably like even with prepared plans and the flow of communication, there's always going to be human flaws or process flaws" (P.G.R.1).* Key informants did note; however, that this challenge should not be used as an excuse to neglect adaptive management efforts.

Additionally, a municipal local government affiliated key informant noted the difficulty of actioning adaptive management initiatives*: "we heard about all types of -you know, different things and what we can expect, -but to be able to bring them back and actually action them/action them through mitigation or action-/is pretty hard and complex" (L.G.M.2)*. Awareness of adaptive management efforts and initiatives is equally as important as the process of how adaptive management efforts and initiatives can be actioned.

5.1.1.3 Needs and Opportunities

A number of diverse and significant needs and opportunities were identified by key informants related to the Adaptive Management theme. First, there appears to be an insufficient baseline understanding of overall natural hazard risks in the greater Pinery Provincial Park region. For example, a regional local government affiliated key informant stated that there is a need to have an: "*understanding of and respect for past hazards" (L.G.R.1).* In order for adaptive management to be effective, the natural hazard risks in the region need to be identified and understood. Climate change possesses the potential to increase the occurrence and severity of such natural hazard risks in the greater Pinery Provincial Park region; moreover, adaptive management efforts and initiatives will be challenged. A regional provincial government affiliated key informant stated: *"I think the increasingly erratic climate patterns are probably one of the most significant, ways to improve, responses and different strategies. And also understanding that because of that, a lot of the stuff we've traditionally done, will not be effective, and coming to terms with that" (P.G.R.1).* An understanding of the natural hazard risks in the greater Pinery Provincial Park region would inform and support effective adaptive management.

Key informants also highlighted the need to create and acquire more data. For example, two respondents emphasized the need for a more robust data set upon which to make informed decisions in addition to more general information related to natural hazards: *"I think probably a more robust data set that could be relied upon" (L.G.R.1),* and, *"I think that there is a need for, you know, consulting with broader information gathered from other sites, but then also, you know, specific information is studies done here to be able to sort of assess what's going on" (P.G.L.1).* Additional data and general information sources would advantageously inform natural hazard adaptive management efforts and initiatives.

Regional provincial government affiliated key informants emphasized their organization's sufficient reactive risk management response to natural hazard events: *"I think it tends to be a little bit more reactive rather than proactive. So, if we have a severe wind, event for instance, and then we're expected to respond to that and we have to sort of, you know, return normal operations, then we might learn some lessons from that and incorporate them into the plan" (P.G.L.1).* While a sufficient reactive risk management response is critical when dealing with natural hazard events, proactive risk management efforts should be explored. A local provincial government affiliated key informant noted that, *"I think it [proactive risk management] would be practical, useful information and also proactive information. That we don't always have to wait until something happens, to learn from it, that, -you know, if, an organization has had, an event happen that we can learn from that" (O.C.A.1).* Key informants addressed a desire to better proactive natural hazard risk management. Proactive risk management efforts and initiatives have the potential to decrease or compliment the degree of reactive response required when a natural hazard event occurs.

Throughout all of the interviews, key informants stressed the need and opportunity for continuous improvement of natural hazard risk management. For example, *"we can only be so prepared- I think as much as you know, we might say we have you seen everything and we're fully prepared to respond, I question anyone that says that. We certainly have had a lot of successes… there's certainly room for growth and challenges" (P.G.R.1).* Genuine adaptive management efforts and initiatives, ensure continuous development of natural hazard risk management.

5.1.2 Theme 2: Greater Collaboration and Partnership is Needed to Enhance Natural Hazard Risk Management

Collaboration and Partnerships was another theme identified when analyzing the key informant's interview transcripts. Collaboration is defined as the act of working with someone for the benefit of a shared objective, and partnerships is defined as the arrangement between two or more people to oversee something and share in its benefits. The Collaboration and Partnerships theme focused on ideas such as: what individuals and organizations collaborate and partner, why individuals and organizations collaborate and partner, and how collaboration is and how partnerships are established and maintained between individuals and organizations, in the greater Pinery Provincial Park region. A number of strengths, weaknesses, needs and opportunities were identified and discussed by the key informants when referencing the Collaboration and Partnerships theme, as summarized in *Table 10*.

Table 10 Theme 2: Summary of strengths, weaknesses, needs and opportunities for the Collaboration & Partnerships theme.

Theme 2: Collaboration & Partnerships
Strengths   • Regional provincial government and local provincial government affiliated key informants described strong collaboration and partnership efforts in the region.   • Local provincial government affiliated key informants noted collaboration and partnerships with academic institutions.   • All key informants suggested that some collaboration and partnerships have been established with Indigenous communities.   • Regional provincial government affiliated key informants will retroactively collaborate and partner with stakeholders if the need for them to be engaged was not initially foreseen.   ***Weaknesses***   • Key informants, not affiliated with regional provincial government or local provincial government, described collaboration and partnerships to be non-existent in the region.   • Public Health sector affiliated key informants are disproportionally excluded from knowing and participating in regional risk management efforts.   • Public Health sector affiliated key informants expressed that stakeholders in the region are working in silos.   • Collaboration and partnerships with Indigenous communities is not yet sufficient in the region.

- Regional provincial government and local provincial government affiliated key informants expressed limited engagement with Parks Canada and Parks Canada's national parks.
- Key informants explained that staff turnover disrupts collaboration efforts and established partnerships.

Needs and Opportunities

- All key informants agreed that more resources are needed to encourage collaboration and partnership efforts in the region.
- Public Health sector affiliated key informants emphasised the need for in-person meetings, as a regional group, to ensure coordinated natural hazard risk management in the greater Pinery Provincial Park region.
- A local provincial government affiliated key informant and a Public Health sector affiliated key informant supported the need and opportunity to form a regional natural hazard risk management committee.
- An 'other conservation agencies' affiliated key informant identified an opportunity to explore the potential benefits of engaging volunteers and volunteer groups in natural hazard risk management.
- Public Health sector affiliated key informants highlighted the need for greater collaboration and partnerships between their organizations and the greater Pinery Provincial Park region.
- All key informants identified a need for greater collaboration and partnerships with local Indigenous communities.
- The need and opportunity to strategically collaborate and establish partnerships with all those willing, was emphasized by all key informants.
- Key informants, not affiliated with regional provincial government or local provincial government, expressed a desire to collaborate and partner with Pinery Provincial Park in general, and specifically when managing natural hazard risks in the region.

5.1.2.1 Strengths

Key informants identified various strengths related to the Collaboration and Partnerships theme. Throughout all 15 of the interviews, key informants were able to identify and elaborate on many examples of collaboration and partnership strengths. A regional provincial government affiliated key informant emphasized that collaboration and partnership efforts within the region were:

> *"quite strong, and I think because a Pinery operates very much like a municipality would just in terms of its infrastructure, emergency response and approach to risk management. And that park, in particular because of its size and use, regularly works with local emergency services, including the O.P.P., fire services from the [municipal local government], Ontario's Aviation Forest Fires and Emergency Services branch of the Ministry of Natural Resources and Forestry" (P.G.R.1).*

A local provincial government affiliated key informant further emphasized the regional collaboration and partnership efforts of by stating, *"for the most part, probably other provincial organizations and- so ministries and agencies… conservation officers, the OPP… engaging with other partners through meetings and, you know, focus groups, conferences and various means like that, where that would happen" (P.G.L.1).*

Not only did the key informant's interviews highlight examples of collaboration and partnership efforts, but they also elaborated on the proven benefits of collaboration and partnership efforts. Collaboration and partnerships with academic institutions and Indigenous communities were mentioned frequently throughout the key informant's interviews. When discussing collaboration and partnerships with academic institutions, a local provincial government affiliated key informant noted that:

> *"in the case of this park, I think a tremendous amount is being learned through academic partnerships with, various researchers and universities through Southern Ontario and beyond to where, often a subject matter expert will come to us. And then over the course of, you know, years to decades, we develop a partnerships that really inform what we do… I would have to rely more on partners, specifically Wilfrid Laurier to, to help sort of inform me of/of the/the ways and means and the possibilities of that kind of (social science) information… We had a really strong partnership with the University of Western Ontario and that really changed the course of action for the park of/of how we restore damaged dunes and how we, you know, move people over top of them. And, and all those kinds of things, educate people about them as well" (P.G.L.1).*

The same key informant elaborated on Pinery Provincial Park's collaboration and partnership efforts with the local Kettle and Stony Point First Nation Indigenous community:

"our history of, Indigenous partnership to do with deer management. So the population of deer in the park became excessively high in the 1980s and early 90s. And since 1998 we've had a very strong partnership with Kettle and Stony, Point First Nation to implement a number of deer herd reductions and their traditional treaty-based harvests. And so we've had a fair degree of involvement with them over that time and they've assisted us greatly in managing the deer population to a more appropriate level and have seen phenomenal recovery of the park ecosystems in that time" (P.G.L.1).

A local provincial government affiliated key informant also stated that, *"the local community, in this case Kettle and Stony Point First Nation… will either take a lead role or a support role in some different, archeological work that we would do" (P.G.R.1).* There is a willingness and genuine intention to collaborate and maintain partnerships with Indigenous communities in the region.

While key informants repetitively noted that there is genuine effort to collaborate and build partnerships with stakeholders in the region, a regional provincial government affiliated key informant truthfully admitted that there are times when stakeholders are initially overlooked; however, stakeholders are *"retroactively [contacted] if it's something that wasn't foreseen before, then they're engaged. That's rare, but sometimes there are groups or agencies or organizations that might not have previously had any involvement or awareness. And so they'd be engaged at that time" (P.G.R.1).* Regional provincial government affiliated key informants are open to working with all stakeholders.

5.1.2.2 Weaknesses

While key informants identified strengths related to the Collaboration and Partnerships theme, numerous weaknesses were also identified. Key informants from the greater Pinery Provincial Park region, that were not directly affiliated with regional provincial government or local provincial government, overwhelmingly expressed collaboration and partnerships within the region to be *"non-existent" (P.H.S.2)*, when it came to natural hazard risk management. Excerpts from the key informant's interviews, such as, *"there is really no coordination of risk management in the region" (P.H.S.3*), and that there is a, *"lack of engagement at the local level between the province and the municipality" (L.G.M.1)*, suggested that there is a lack of collaboration and partnerships within the greater Pinery Provincial Park region.

While key informants expressed an overall lack of collaboration and partnerships within the region, interviews specifically with Public Health sector affiliated key informants exposed their disproportionate exclusion from knowing and participating in regional risk management efforts. The interviews identified that this exclusion of Public Health sector affiliated key informants is not intentional; however, the exclusion is a grave barrier to effective risk management.

Another weakness related to the Collaboration and Partnerships theme was related to working in silos. A Public Health sector affiliated key informant identified that: *"unfortunately people still work very much in silos, but-it's really about breaking these silos down, and really having that common goal" (P.H.S.3)*; however, while this was an identified weakness, the evidence of reflection proves promising for future collaboration and partnership efforts between all stakeholders and organizations with a role in risk management, in the region.

Additionally, while some key informants identified a willingness and genuine intention to collaborate and maintain partnerships with Indigenous communities in the region, other key informants alluded to a lack of collaboration and partnerships with Indigenous communities:

> *"I would say that, well- I'll just be black and white, people on the whole have not done a great job at, partnering with our Indigenous communities. So, I think that/that's a way forward that we can go with, but it's going to take time and it's going to take building of trust between that community and everybody else" (P.H.S.3)*.

The evident divide amongst how key informants view collaboration and partnerships with Indigenous communities, proves that there is need to focus more on collaboration and partnerships with this specific stakeholder.

Regional provincial government and local provincial government affiliated key informants also noted a lack of collaboration with national parks. The closest national park geographically would be: Bruce Peninsula National Park. A local provincial government affiliated key informant stated that, *"we have several national parks close by. We meet and collaborate, minimally" (P.G.L.4)*. While the regional provincial government and the national government have organization-specific idiosyncrasies, their operation within natural areas would suggest that there is much to be learned from one another. The risk

management efforts implemented proactively or reactively, to address natural hazards, should be shared between these two organizations.

Lastly, staff turnover, specifically due to retirement, was identified as a weakness related to the Collaboration and Partnerships theme. A regional provincial government affiliated key informant stated, *"people move on from their roles, sometimes that/that can interfere with/with partnerships" (P.G.R.2)*; moreover, genuine efforts need to be made to ensure the retention of established partnerships.

5.1.2.3 Needs and Opportunities

Key informants identified needs and opportunities related to the Collaboration and Partnerships theme. Supported by all key informants, during their interviews, was the idea that, *"more resources [are needed] when it comes to establishing partnerships" (P.G.R.2)*. Money, time and staff, are some examples of resources that would aid collaboration and partnership efforts.

While key informants initially identified working in silos to be a weakness related to the Collaboration and Partnerships theme, key informants also provided examples of opportunities that would improve this weakness. Key informants suggested that collaboration and partnerships between stakeholders, with a role in natural hazard risk management in the region, could be improved if genuine efforts were made to gather as a group, specifically emphasizing the importance of meeting in-person: *"we have to get together. I mean, we have to/we have to sit down and, work on this as a collective group. We can't do it individually… there's gotta be a coordinated effort" (P.H.S.4)*. Key informants further suggested that a committee should be formed to support collaboration and partnerships related to natural hazard risk management in the region: *"sort of start up a committee I guess and then start a… committee that can start looking out or reaching out to the organizations and asking for names" (P.G.L.3)*. Genuine efforts to action the opportunities, volunteered by the key informants above, would begin to improve collaboration partnerships in the region.

An 'other conservation agencies' affiliated key informant emphasized, during their interview, the need for more attention to be paid to the role of volunteers when managing natural hazard risks, *"we're also looking at developing like volunteer steered groups for our properties" (O.C.A.2)*. Volunteers can be used as a labour source. Volunteers are a unique labor source as, "they are not bound by the extrinsic reward associated with paid employees; therefore, as volunteers give of their time they want and need to feel that they have made a valued contribution" (Douglas & Rollins, 2007).

Public Health sector affiliated key informants noted both their absence from and desire to be included in natural hazard risk management efforts in the region. For example, P.H.S.3 noted:

> *"they [stakeholders in the region] have to include the hospitals… I think we need to be better connected with what the EMS or the Emergency Medical Services doing… I don't think that's very clear about- in this whole area, whether it be Grand Bend itself but the Pinery, you know, if we do have a/a fairly major natural disaster, I don't think people know what they're supposed to do or where they're supposed to go".*

Moreover, collaboration and partnerships with Public Health sector staff play a critical role in the success of natural hazard risk management efforts and outcomes.

A key informant also noted that, *"Indigenous knowledge… we don't have as many -well it our/our connections to the local community aren't as strong as I would like. So I think that, that's an area for improvement" (P.G.R.2)*; however, these connections can be strengthened by genuine collaboration and partnerships with the local Kettle and Stony Point First Nation Indigenous community.

While there is undeniable benefit to specifically collaborating and establishing partnerships with the Public Health sector and local Indigenous communities, collaboration and partnerships should be strategically fostered with all those willing: *"I'd love to learn from other jurisdictions, other park agencies, other, you know, far beyond the boundaries of Ontario" (P.G.L.1)*, and available:

> *"I think, [regional provincial government] has already and could continue to learn a lot from the Aviation Forest Fire and Emergency Services division of the Ministry of Natural Resources and Forestry because they, you know, not to speak lightly, but they/they kind of operate almost in a military like format, where they have a lot of very rigorous protocols, training mechanisms, after action review" (P.G.L.1)*.

Lastly, nine of the 15 key informants, who were not directly affiliated with regional provincial government or local provincial government, acknowledged concern over the lack of engagement with Pinery Provincial Park. For example, a municipal local government affiliated key informant stated: *"I would suggest -I've never been invited to the park to actually understand what their concerns are"*

(L.G.M.2). The same municipal local government affiliated key informant directly addressed the opportunity to improve collaboration and the value of establishing a more involved partnership with Pinery Provincial Park, stating:

> *"something interesting is the Pinery as an entity isn't at this table. So it's municipalities. You know, we have these untapped things. We have these large industries or larger risks, that are/aren't at a table. And, -you know, so it's kind of interesting, whereas different when I work/worked in Durham, we had nuclear power station, and they were at the table. Obviously, a big risk. They're at the table with the municipality- they were perceived at least, as the -one of the larger risks. So, it's something that could be maybe improved upon too" (L.G.M.2).*

Natural hazard risk management in the greater Pinery Provincial Park region would benefit if key informants focused genuine efforts on collaborating and partnering with Pinery Provincial Park. Overall, the key informant's abilities to identify numerous needs and opportunities related to the Collaboration and Partnerships theme suggested that many of the weaknesses with respect to risk management in the greater Pinery Provincial Park region are known, paving the way for more effective partnerships in the region.

5.1.3 Theme 3: Enhancing Natural Hazard Risk Management Requires Greater Communication

When analyzing the key informant's interview transcripts, Communication was another theme identified. Communication is the means of giving or receiving knowledge. The Communication theme focused on ideas such as: how knowledge, and specifically natural hazard risk management knowledge, is communicated, and what mediums are used to communicate such knowledge, internally or externally, between individuals and organizations, in the greater Pinery Provincial Park region. A summary of strengths, weaknesses, needs and opportunities is presented in *Table 11*. A detailed summary of this theme follows.

Table 11 Theme 3: Summary of strengths, weaknesses, needs and opportunities for the Communication theme.

Theme 3: Communication
Strengths

- Internal communication is perceived as strong within regional provincial government and local provincial government organizations.
- Regional provincial government and local provincial government affiliated key informants actively communicate with legal counsel and insurance companies.
- All key informants indicated that they communicate in both formal and informal ways.
- Regional provincial government affiliated key informants are very conscious of perception when it comes to external communication.
- All key informants provided evidence to suggest that communication with local Indigenous communities occurs.
- All key informants provided evidence to suggest communication with local residents occurs.

Weaknesses

- Key informants, not directly affiliated with regional provincial government or local provincial government, described a lack of communication with Pinery Provincial Park.
- A regional provincial government affiliated key informant noted that politics can hinder the feasibility of communication.
- A regional local government affiliated key informant expressed that communication is a "two-way street;" yet, not all external stakeholders are willing to participate.

Needs and Opportunities

- All key informants identified a need to increase communication.
- All key informants identified a need for more external communication with stakeholders in the region, and specifically stakeholders who have a role in natural hazard risk management efforts.
- Public Health sector affiliated key informants need to be included in natural hazard risk management communications, in the region.
- All key informants addressed the need for persistent and genuine efforts to communicate with local Indigenous communities.
- There is a general need in the region to strategically, optimize social media, when externally communicating natural hazard risk management information.

5.1.3.1 Strengths

Key informants identified and discussed various strengths related to the Communication theme. For example, the key informants directly affiliated with regional provincial government and local

provincial government confidently reflected on their internal communication abilities: *"part of the benefit of our diverse work is that we are able to frequently contact a lot of other jurisdictions and agencies and stakeholders and have these conversations" (P.G.R.1)*, and, "*we're always talking with other parks and partners about, issues that we're having and/and solutions that we've come up with or they've come up with" (P.G.R.2)*. Internal communication is strong within the regional provincial government and the local provincial government.

There was also frequent mention of communication between legal counsel and insurance companies, *"we do have legal counsel on staff. We have people that we could consult with regards to insurance on staff and associated with us" (O.C.A.2)*, by the regional provincial government and local provincial government affiliated key informants. Communication with legal counsel and insurance companies strategically minimizes loss and liability.

Key informants noted a distinction between formal and informal communication, when sharing natural hazard risk management knowledge with stakeholders in the region: *"so, there are, very structured, formal ways that we communicate. But there's also a lot of informal communication that happens, that often does feed into the formal practices over time" (P.G.R.1)*; furthermore, formal and informal communication should both be considered when it comes to sharing natural hazard risk management knowledge.

A regional provincial government affiliated key informant highlighted the degree of importance that their organization places on perception, *"we're very conscious of perception, I think that's a very significant consideration in order to be able to get the message across and understand, and be able to relate to why" (P.G.R.1)*. How the organization will be perceived is thoroughly considered when communicating in general, but specifically when communicating externally with the public. The public's perception of the regional provincial government, greatly influences the way knowledge is communicated by this organization.

Key informants noted that communication with local Indigenous communities occurs. For example, P.H.S.4 noted:

> *"yeah, it/it's/it's, there are individuals [Indigenous community members] out there you can reach out to. I know of a few that I could, you know, that I could call and talk to about anything specific, that I would want to know background information about. But, yeah,*

there's, it's/it's not, there's a fair amount of difficulty in connecting. And it's/it's not, I/I can't say it's because people haven't tried, it just, they kind of have their thing and you have to be invited to and you have/there has to be a certain amount I think of trust before you're invited. So it takes a lot of building that trust. But certainly, we do communicate."

However, the interview responses also raised questions around the quality of this communication.

Additionally, the statement: *"a park like Pinery that is so prominent, especially from the local perspective,… people already know about what's going on and we're able to have those conversations" (P.G.R.1)*, made by a local provincial government affiliated key informant, supports the assumption that communication with local residents is a strength in the region. Communication, and specifically transparent communication, with local residents promotes trust.

Throughout the interviews, key informants provided numerous examples of the ways that natural hazard risk management is communicated. Key informants identified specific roles that were created to ensure effective communication: *"also [we] have our communications officer whose job is some internal communications, but also external communication. So we're very active through social media and stuff like that. So things are disseminated out that way" (L.G.M.2)*, materials that are distributed to heighten communication*: "we do focus on a lot of communication, whether that's through public notices or, open houses where we would offer, you know, information on not only the process of doing something… but also, on the benefits of it and the science behind it" (P.G.R.1)*, and organized events that are strategically hosted to assist the communication of natural hazard occurrences and risk management initiatives: *"Emergency Preparedness Day that I referenced earlier is a/is a huge ah- component of public ed as well. And, the other is just constantly pushing the public to sign up for My Community Notification Network, which is a public alerting system, to deal with hazards in our community" (L.G.R.1)*. Natural hazard risk management information is being communicated in the greater Pinery Provincial Park region.

5.1.3.2 Weaknesses

While the key informants discussed various strengths during their interviews related to the Communication theme, significant weaknesses were also identified. Key informants, who were not affiliated with regional provincial government or local provincial government, all identified communicating with the Pinery Provincial Park as the most common weakness in the region. A Public Health sector affiliated key informant noted: *"as far as partners go, like the Pinery and that like we just*

don't, we don't commu-/there's not a lot of communication… I don't think that they/they talk a lot to the municipality? I don't think they really engage… I don't really know that they/they talk that much to the communities" (P.H.S.4). Communication, similar the Collaboration and Partnership's theme, is siloed in the greater Pinery Provincial Park region. An 'other conservation agencies' affiliated key informant went even further to suggest a general lack of communication in the region:

> *"in terms of communication for other types of hazards, we haven't really had the situations where- like when the tornado nearly went through the Pinery, we didn't have any conversations with them- sort of thing, so… I would say that we don't really. We don't get together as -you know, the Pinery region is actually a/a good example because within the Port Franks area, which is right beside the Pinery, we'll have, of course the province, Nature Conservancy [of Canada], Scouts Canada and Lambton Wildlife Incorporated, we all own natural areas within this/within this area. And so we don't really meet together to talk about those things" (O.C.A.1)*.

Communication between all stakeholders in the greater Pinery Provincial Park region, who have a role in natural hazard risk management, ought to be prioritized.

Another weakness relevant to the Communication theme was mentioned by a regional provincial government affiliated key informant: *"the only barrier would be again political and getting authorization to ah to- authorization to communicate outside the organization" (P.G.L.3)*. While there may be a willingness to communicate with external stakeholders in the greater Pinery Provincial Park region and beyond, politics can hinder the feasibility of such communication.

Lastly, key informants emphasized that communication "*has to be a two-way street" (L.G.R.1)*. A regional local government affiliated key informant further elaborated:

> *"you can communicate with somebody, through all the different means and tactics that you can come up with, but they have to want to hear it, and they have to want to understand it, and they have to want to act on it. Right? So a lot of- there/there's a point in time where, the responsibility shifts from the communicator to the communicatee and, and you, no matter how much you want to try, we can-/we can't change somebody's will to do that. Right? That, yeah. That's something I think people are always/always gunna struggle with" (L.G.R.1)*.

Communication efforts may not always be successful; however, persistent communication efforts should still be encouraged.

5.1.3.3 Needs and Opportunities

Key informants discussed various needs and opportunities related to the Communication theme. Key informants frequently made mention of the need to increase communication. An increase of in-person communication; however, was specifically emphasized, *"from/person-to-person is always good cause you can have the conversation and/and not as opposed to just sitting down and reading it. I think that's one of the keys at/at a very local level. I think the higher-level stuff could be done more on a written type document -sort of thing" (P.G.L.2)*. A Public Health sector affiliated key informant further elaborated on the need for in-person communication and provided an example of how this in-person communication could come to fruition:

> *"well, probably the best way to do that would be to have, you know, a community meeting at least once a year where you would sit down with the people that are 'in the know' and have those discussions. Because right now there is no, there's nothing. So there should be some sort of a gathering. I'm as/I'm assuming- I mean possibly the Pinery talks to the [municipal local government], maybe on a yearly basis. Like I'm not aware of that, but I mean, I know we're/we're not involved in any kind of discussions with what the Pinery does" (P.H.S.4)*.

In today's increasingly online world, key informant's interview responses suggested that in-person communication should remain valued and prioritized.

While key informants provided sufficient examples to deem internal communication a strength: *"well, at times we have it, right? And I think in/in/in all the times of those emergencies, when information is flowing well, it's always because of good communication. Right?" (L.G.M.1)*, key informants emphasized the need for more focus on external communication with stakeholders in the region, and specifically stakeholders who have a role in natural hazard risk management efforts: *"but I think where it lacks- is internally that's fine, but externally, if you know those other stakeholders are not, engaged or not communicating or you don't even really know who they are, then it's/it's bridge over troubled water because you really don't have/have the necessary people at the table" (L.G.M.1)*. External communication with stakeholders in the region, and specifically stakeholders who have a role in

natural hazard risk management efforts, will improve natural hazard risk management in the greater Pinery Provincial Park region.

Public Health sector affiliated key informants emphasized the need to be and benefit of being included in regional, natural hazard risk management communications:

> *"we don't always communicate with them- one another. You know, so I guess that's the- I mean, everybody's somewhat siloed, right? So I think that's probably a bit of an issue. Now mind you, the [Public Health sector], we actually share staff between the [Public Health sector] and here. So we, we are, in with the [Public Health sector], but we've never done a joint disaster plan with the h[Public Health sector] [or other stakeholders]. But I think I could see that quite easily happening" (P.H.S.4)*.

In the event of a natural hazard risk, Public Health sector affiliated key informants would play a critical role in the natural hazard risk response; moreover, communication with such stakeholders is paramount.

A Public Health sector affiliated key informant reflected on their organization's communication efforts with the local, Kettle and Stony Point First Nation, Indigenous community, *"certainly we do communicate. I know we just recently, had some interviews out in the Kettle Point area that we were doing…, so we did seek out people from the Kettle Stony Point area and had them participate in that, so we could find out, what their thoughts were. But, it was/takes a lot of work to make those inroads to you know even get in" (P.H.S.4)*. All key informants addressed the need for persistent and genuine efforts to communicate with local Indigenous communities.

Additionally, key informants specifically discussed the potential of social media when communicating with external stakeholders. For example, a Public Health sector affiliated key informant emphasized that: *"social media is huge" (P.H.S.4)*. A municipal local government affiliated key informant reflected:

> *"well -once again, I think just, you know, striving for consistent, one of the biggest things is consistent messaging, when it comes down to it. Striving for consistent messaging. Minimizing any erroneous information… I think that's probably the number one way of getting credibility is you're consistent with your messaging and the messaging is correct" (L.G.M.2).*

Social media can be an effective communication tool if used strategically. Overall, key informants were able to suggest numerous needs and opportunities, that would better the future of natural hazard risk management communication in the region.

5.1.4 Theme 4: Acquiring All Forms of Knowledge Leads to More Robust Natural Hazard Risk Management

Knowledge Acquisition was yet another theme identified when analyzing the key informant's interview transcripts. Knowledge acquisition is defined as how knowledge is obtained. The Knowledge Acquisition theme focused on ideas such as: what, why and how individuals and organizations in the greater Pinery Provincial Park region obtain knowledge. A number of strengths, weaknesses, needs and opportunities were identified and discussed by the key informants when referencing the Knowledge Acquisition theme, as summarized in *Table 12*.

Table 12 Theme 4: Summary of strengths, weaknesses, needs and opportunities for the Knowledge Acquisition theme.

Theme 4: Knowledge Acquisition
Strengths   • Key informants leverage subject matter experts and their expertise.   • Key informant's organizations often employ capable staff.   • Key informants acquire knowledge in both formal and informal manners.   • A local provincial government affiliated key informant indicated that the public is able to acquire natural hazard risk management knowledge rather easily.   • Overlap hiring is a knowledge acquisition strategy employed by the local provincial government when staff plan to transition to other roles or organizations and when staff plan to retire.
Weaknesses   • Regional provincial government and local provincial government affiliated key informants stated that the costs associated with acquiring knowledge inhibit knowledge acquisition.   • A local provincial government affiliated key informant expressed that all of the site-specific knowledge needed does not yet exist.

- A Public Health sector affiliated key informant described the overwhelming nature of knowledge acquisition to be a barrier.
- Public Health sector affiliated key informants echoed the expression: "you don't know, what you don't know," when it came to acquiring knowledge.

Needs and Opportunities

- All key informants stated that there is a need to understand where to acquire all different forms of knowledge, specifically: social science knowledge, traditional ecological knowledge, Indigenous knowledge, and other forms of local knowledge.
- All key informants, with the exception of Public Health sector affiliated key informants, identified a need to acquire site-specific knowledge from stakeholders with a role in risk management, in the greater Pinery Provincial Park region.

5.1.4.1 Strengths

Knowledge acquisition was identified and discussed as a strength in many of the key informant's interviews. When acquiring knowledge, a municipal local government affiliated key informant stated: *"like any other, organization, you beg, borrow and steal the best ideas and you see what else is out there" (L.G.R.1)*. If the required knowledge already exists it should be strategically acquired; one does not need to "reinvent the wheel."

Accessing subject matter experts was a strength identified by key informants, related to the Knowledge Acquisition theme. A regional local government affiliated key informant provided an example of how their regional local government acquires knowledge from subject matter experts:

> *"we brought in, some of the subject matter experts from our local Conservation Authorities and, and coordinated presentations to be made to the local municipalities, to engineers, to planners, to building inspectors to emergency management people so that, we're leveraging the expertise of our Conservation Authorities and equipping all the local municipalities with that same base level of understanding" (L.G.R.1).*

The knowledge acquired from subject matter experts informs stakeholder's understandings of natural hazard risks, in the greater Pinery Provincial Park region.

Knowledge acquisition was deemed a strength; yet again, when key informants highlighted the capable staff their organizations employ. For example:

> *"we're fortunate for the organization we work for, whether it be the Ministry of Natural Resources and Forestry or the Ministry of Environment, Conservation and Parks, who we work with, a network of people that have resources available and we employ some smart, competent people that are aware of this before we're. They're aware of the information, before we're being told of the information, which is very helpful for us" (P.G.L.4)*.

Intentionally employing capable staff, is an act of knowledge acquisition.

Additionally, knowledge acquisition was deemed a strength as knowledge was described to be acquired in both formal and informal manners. Examples of formal knowledge acquisition were provided by a local provincial government affiliated key informant: *"we would access academic journal articles, you know, on a more or less routine basis as they come across our desk that would start to inform what we do" (P.G.L.1)*, and an 'other conservation agencies' affiliated key informant:

> *"our/our board of directors, they're knowledgeable people with -I would say, that community knowledge and familiarity with the/with the areas that we manage, and to know what's reasonable and/and what would work, so… taking the risk management, webinars or 1 or 2 day courses -sort of thing or/or right now, the conservation areas- a lot of the staff are at a conference right now" (O.C.A.1).*

Informal knowledge acquisition examples were provided by a regional provincial government affiliated key informant: *"most of our knowledge just comes from speaking informally with people" (P.G.R.2)*, in addition to a local provincial government affiliated key informant:

> *"I will be reaching out to Killbear Provincial Park as they just went through the- the beech bark disease, so, so they had to clear out all their beech, so I'm going to have to talk to them do you have it and what was their strategy and/and get it down here and have a look at it, and see if we can use it to deal with oak" (P.G.L.3).*

Formal and informal knowledge acquisition should be equally valued.

A local provincial government affiliated key informant identified another Knowledge Acquisition theme strength, that specifically addresses the public's acquisition of natural hazard risk management knowledge, *"with respect to wind, I would say, you know, they're [the public] more on the receiving end of information that's disseminated out by, you know, emergency alerts and weather bulletins" (P.G.L.1)*. The public is able to acquire natural hazard risk management knowledge rather easily.

Another knowledge acquisition strength addressed the value of overlap hiring. Overlap hiring is when a new hire is appointed before the original employee separates. A local provincial government affiliated key informant discussed overlap hiring, specifically when staff, who have worked for their organization for many years, plan to retire: *"one of the biggest things I've been trying to do with my managers is get them to -if we can swing it, to get that overlap, so there's a better transfer of information between the two of them" (P.G.L.2)*. Overlap hiring is a knowledge acquisition strategy; moreover, a strength related to the Knowledge Acquisition theme.

5.1.4.2 Weaknesses

Weaknesses were identified by key informants related to the Knowledge Acquisition theme. The cost of acquiring knowledge was a weakness identified by key informants. For example: *"paywalled research articles, are always a bit of a barrier" (P.G.R.2)*. Open access knowledge sources enable knowledge acquisition.

Acquiring site-specific knowledge that does not yet exist, was another weakness related to the Knowledge Acquisition theme. A local provincial government affiliated key informant elaborated: "*it's just, it's not always there. What sometimes the/the information is just not there to get, and then there's all/there's/there's always/the always/ the challenge is/is, sometimes that data's not the right format and we don't have the staff" (P.G.L.2).* Natural hazard knowledge specific to the greater Pinery Provincial Park region would greatly inform risk management efforts.

The overwhelming nature of knowledge acquisition was yet another weakness identified. A Public Health sector affiliated key informant stated: *"it's hard- because it's just overwhelming- the amount of information that's out there that needs to/to sometimes be gathered and we've got 10 other things that we're doing" (P.H.S.4).* While knowledge acquisition can be overwhelming, it is still a task that should be prioritized.

A common expression used by key informants when asked about knowledge acquisition was: "you don't know, what you don't know." When it came to acquiring knowledge, a Public Health sector affiliated key informant stated: *"mhm ya, well you have to know the questions to ask. You don't know if you don't know, and how do you find out and then its sometimes that's half the battle is like what is it that you want to know, again to get it- it goes back to: you don't know something you don't know" (P.H.S.1)*. Engagement with stakeholders in the greater Pinery Provincial Park region would assist in identifying what knowledge is "unknown," that then what knowledge should be intentionally acquired.

5.1.4.3 Needs and Opportunities

Needs and opportunities related to the Knowledge Acquisition theme were identified by key informants, during their interviews. Key informants stated that there is a need to understand where to acquire all different forms of knowledge, but specifically: social science knowledge, traditional ecological knowledge, Indigenous knowledge, and other forms of local knowledge. For example, a municipal local government affiliated key informant echoed this need, stating that there is a need to understand: *"where to access it. So it's/it's/it's/it's where the access points are for the information" (L.G.M.2)*. Once stakeholders in the greater Pinery Provincial Park region know where to acquire different forms of knowledge, specifically: social science knowledge, traditional ecological knowledge, Indigenous knowledge, and other forms of local knowledge, it is likely that these forms of knowledge will start to be more frequently and genuinely integrated into natural hazard risk management.

Key informants also identified a need to acquire site-specific knowledge from stakeholders with a role in risk management, in the greater Pinery Provincial Park region. A municipal local government affiliated key informant explained: "*I think, probably from our point of view, is - we probably don't have the information that readily available down to a/a municipal level organization… you know, our department is/is fairly thin on knowledge. I personally don't have a lot of knowledge, I'm a student of it" (L.G.M.2).* The same municipal local government affiliated key informant however, identified an opportunity to acquire the necessary site specific knowledge from stakeholders with a role in risk management, in the greater Pinery Provincial Park region: *"if you are aware of something, there's usually/you can reach out, and generally when you reach out, organizations with/with knowledge and expertise -for the most part, make themselves readily available or certainly play nice with you" (L.G.M.2).* Key informants should intentionally seek to acquire knowledge from stakeholders with a role in natural hazard risk management, in the greater Pinery Provincial Park region. Overall, key informants

were able to identify and provide various examples of Knowledge Acquisition theme needs and opportunities.

5.1.5 Theme 5: All Forms of Knowledge Should Be Integrated into Natural Hazard Risk Management Decision-making

Knowledge Integration and Decision-making was another theme identified when analyzing the key informant's interview transcripts. Integration is defined as the act or process of combining things in an effective way, while decision-making is the act of choosing; furthermore, the Knowledge Integration and Decision-making theme focused on ideas such as: why and how individuals and organizations in the greater Pinery Provincial Park region combine various forms of knowledge (e.g. natural science, social science, traditional ecological, Indigenous, local) in an effective way to inform natural hazard risk management choices. Strengths, weaknesses, needs and opportunities were coded to the Knowledge Integration and Decision-making theme, as summarized in *Table 13*.

Table 13 Theme 5: Summary of strengths, weaknesses, needs and opportunities for the Knowledge Integration & Decision-making theme.

Theme 5: Knowledge Integration & Decision-making
Strengths   • All key informants indicated that genuine efforts are being made to integrate various forms of knowledge into decision-making.   • All key informants noted that natural science knowledge is the most common form of knowledge integrated into decision-making.   • Regional provincial government affiliated key informants stated that social science knowledge is being integrated into decision-making.   • Local provincial government affiliated key informants integrate tacit, experiential knowledge into decision-making.   • A regional provincial government affiliated key informant explained that *reversibility* is considered when making decisions.   ***Weaknesses***   • Key informants, with the exception of regional provincial government affiliated key informants, did not provide sufficient evidence to suggest that social science knowledge is being adequately integrated into decision-making.

- Key informants did not provide sufficient evidence to suggest that traditional ecological knowledge, Indigenous knowledge and other forms of local knowledge, is being adequately integrated into decision-making.

Needs and Opportunities

- All key informants identified the need and opportunity to more fully integrate social science knowledge into natural hazard risk management decision-making.
- All key informants identified the need and opportunity to more fully integrate traditional ecological knowledge, Indigenous knowledge, and other forms of local knowledge, into natural hazard risk management decision-making.

5.1.5.1 Strengths

Key informants identified various strengths related to the Knowledge Integration and Decision-making theme. A regional provincial government affiliated key informant described what risk-based considerations are taken into account when making decisions:

> *"looking first at safety and then at, the risk to the natural environment. Those are sort of the two pillars I would say from my perspective. And then, from there, there's several other risk-based considerations that would be at a smaller scale and that might include things like revenue as we do run under a business model, so how I would risk, impact/impact that and our ability to be a sustainable organization with a… cost recovery for example, park visitor enjoyment, our ability to conduct, science and research, as well as, recreational opportunities. So, there's a… multitude of things that would fall under those different scales, but essentially they would be under those topics of: recreation, education and science" (P.G.R.1).*

The risk-based considerations outlined by the regional provincial government affiliated key informant, directly align with their organization's dual mandate, which prioritizes visitor experiences and ecological integrity.

Key informants indicated, during their interviews, that genuine efforts are being made to integrate acquired knowledge into decision-making. An 'other conservation agencies' affiliated key informant explained:

> *"as we learn things, we're constantly trying to make sure that we're integrating everything that we've learned, kind of collectively. That's partly my role, in that I see stuff from all over Ontario, so someone had a great idea over here, then I'll try and integrate it over here if it makes sense to do so. So just kinda managing all the information and making sure it's used" (O.C.A.2).*

A local provincial government affiliated key informant also elaborated on how knowledge is being integrated into their organization's decision-making:

> *"we are constantly, engaged with academic partners or onboarding academic progress through publications where we try to, you know, adjust our behavior and incorporate that new knowledge so that we can do a better job of protecting… So working with academics or attending, you know, regional conferences, those kinds of things. The ability to interact with other counterparts within [the regional provincial government] who are maybe dealing with the same species in a different area of their range. So there's a lot of, sort of, you know, webinars and, and means for getting that information out so that we can then incorporate it into our, our park specific activities" (P.G.L.1).*

There is a genuine intention to effectively integrate acquired knowledge into decision-making in the greater Pinery Provincial Park region.

Key informants unanimously agreed that natural science knowledge is the most common form of knowledge integrated into decision-making; moreover, this was coded as a strength related to the Knowledge Integration and Decision-making theme. Statements from key informants, such as: *"I think natural science data is, makes itself pretty plain. So it's easy to incorporate" (L.G.R.1)*, *"most of our decisions are kind of biologically-driven because our mandate is to conserve biodiversity" (O.C.A.2)*, and, *"I think having like, the scientific sort of, biology and ecology information- is often easier to integrate because, I would say generally speaking, it's more predictable… processes are more agreed upon and I think standards are more established, so it becomes easier for that" (P.G.R.1)*, support the conclusion that natural science knowledge is the most common form of knowledge integrated into decision-making.

Integrating social science knowledge into decision-making was also coded as strength related to the Knowledge Integration and Decision-making theme. Social science was confidently referenced as a form of knowledge integrated into decision-making, by a regional provincial government affiliated key informant:

> *"I would say that the social science aspect is a fundamental consideration that we make in all of/most of our decisions, but specifically risk management because as a government organization, we are often viewed in a very critical lens, I'll say in terms of, how we're carrying out our business and especially in terms of like how we're using financial resources" (P.G.R.1).*

The integration of social science knowledge into decision-making advantageously informs natural hazard risk management.

The integration of tacit, experiential knowledge was another strength coded to the Knowledge Integration and Decision-making theme. A local provincial government affiliated key informant explained that:

> *"a lot of what goes into each decision is experience. Between myself and other staff within the park, we/so we have maintenance staff, most of them each have about 30 years' experience on the job. I have over twenty-five years of experience. So we have a fair bit of background in whether it be: how do identify hazard tree, how to address it. We have a fair bit of experience in being aware of the natural environment we work in, and how to protect it and the park users. So it's not as much of a/you don't really pull out the binders to see what you're supposed to do for hazard tree" (P.G.L.4)*.

One form of knowledge is not more important than another; moreover, it is beneficial to consider and include all forms of knowledge.

Another strength coded to the Knowledge Integration and Decision-making theme addressed the emphasis placed on reversibility. A regional provincial government affiliated key informant explained that when integrating knowledge into decision-making, their organization looks:

"at things like reversibility as well. So, can the action that we're taking now be modified or reversed if it's not deemed to be the most effective course of action, in the future… because we're a part of the provincial government- any political considerations that we might need to have, in terms of what we're doing and impacts to provincial resource, local economy, that sort of thing" (P.G.R.1).

The consideration of reversibility when integrating knowledge into decision-making was unique to the regional provincial government organization.

5.1.5.2 Weaknesses

The weaknesses coded to the Knowledge Integration and Decision-making theme were all related to the lack of social science knowledge and traditional ecological knowledge, Indigenous knowledge and other forms of local knowledge, being integrated into decision-making. While social science was referenced as a form of knowledge integrated into risk management, and specifically natural hazard risk management, the interviews did not suggest that it is being *adequately* integrated into decision-making. A municipal local government affiliated key informant stated, during their interview, that: *"I'm not aware of any barriers [to accessing social science information]. It's probably just something that… It's just not done that often, I guess" (L.G.M.1)*. A local provincial government affiliated key informant also expressed that social science is, *"not my area of expertise, but I would say social science is more of an opinion… And that's much harder to defend" (P.G.L.2).* While conducting the interviews, it became apparent that the majority of key informants did not understand what "social science" was; moreover, this may be the reason for why social science is not *adequately* integrated into decision-making in the greater Pinery Provincial Park region.

Similar to social science knowledge, key informants agreed that traditional ecological knowledge, Indigenous knowledge and other forms of local knowledge, are not being adequately integrated into risk management, and specifically natural hazard risk management, decision-making. Some reasons for why traditional ecological knowledge, Indigenous knowledge and other forms of local knowledge, are not being integrated into risk management, and specifically natural hazard risk management, decision-making included: *"the traditional knowledge, just being traditional knowledge -lacking statistics, and lacking reports and stuff like that. So, it's anecdotal-kind-of storytelling" (L.G.M.2)*, and *"Indigenous knowledge for instance would be very site specific and community specific. They may have nuances that, you know, apply here but not down the road at another site" (P.G.L.1)*. Traditional ecological

knowledge, Indigenous knowledge and other forms of local knowledge, need be adequately integrated into risk management, and specifically natural hazard risk management, decision-making.

5.1.5.3 Needs and Opportunities

Key informants identified various needs and opportunities throughout their interviews, related to the Knowledge Integration and Decision-making theme. Key informant's interview responses proved the unequivocal integration of natural science knowledge into decision-making. The needs and opportunities, identified by the key informants, directly correlated with the weaknesses identified previously; moreover, the needs and opportunities identified by the key informants focused on integration of social science knowledge and traditional ecological knowledge, Indigenous knowledge, and other forms of local knowledge, into regional decision-making.

A regional provincial government affiliated key informant made an argument to support the integration of social science knowledge into natural hazard risk management decision-making: *"so much of managing a park, that's as busy as Pinery, is managing user behavior, and the social sciences are our best tool for that" (P.G.R.2).* A local provincial government affiliated key informant initially stated: *"I will admit that I have a bias towards natural science. It's my background. I have, you know, two degrees in based in/in natural science. And so I think it's an area that I'm just more experienced with and more familiar with. The social science stuff is really, quite foreign to me" (P.G.L.1)*; yet this key informant later identified an opportunity to ensure social science knowledge is integrated into natural hazard risk management decision-making:

> *"so, I would have to rely more on partners, specifically Wilfrid Laurier to, to help sort of inform me of/of the/the ways and means and the possibilities of that kind of information… I think also just the history of protected areas where they sit within government ministries has always been more closely aligned with sort of natural sciences and resource protection, as opposed to, you know, for instance, social science, which is, you know, a much newer area. And I think because of that, there's a level of comfort with a lot of the employees that they understand and are more familiar with natural science-based information and some of the things like social sciences, just a little bit more novel and it takes longer for them to sort of, you know, accept maybe or to understand the full potential for that kind of information" (P.G.L.1).*

Social science needs be adequately integrated into risk management, and specifically natural hazard risk management, decision-making.

Key informants were also able to identify the need and opportunity to more fully integrate traditional ecological knowledge, Indigenous knowledge, and other forms of local knowledge, into natural hazard risk management decision-making. A local provincial government affiliated key informant explained that:

> *"[The regional provincial government] usually has a very good working relationship with First Nations. So that's/we usually can access them and then they will tell us their stories and/and/and that sorta thing. Sometimes it's a matter of how do you in/in/interpret that information. But, I would say probably the biggest thing is it's not in the forefront of people's mind, of something to go and get" (P.G.L.2)*.

Another local provincial government affiliated key informant reflected:

> *"in some areas, I do suspect it [Indigenous knowledge] is incorporated in/ah this time. From my own perspective, it's not ah/it's not a large component of- it might just be a matter of/a matter of time. So if anything, how will that someday become more part of the decision-making process? I think it's a somewhat of a personnel, their own preference for how they obtain information and how they utilize it. I can anticipate in some areas, staff in the same type of position I have, utilize Indigenous knowledge in a maybe a more proactive way and would make decisions based on that. At this time though, it's here locally, it's not used much" (P.G.L.4).*

Purposely integrating traditional ecological knowledge, Indigenous knowledge, and other forms of local knowledge, into natural hazard risk management decision-making, in the greater Pinery Provincial Park region, requires genuine and timely attention. Stakeholders with a role in natural hazard risk management in the greater Pinery Provincial Park region ought to see value in and have a willingness to integrate all forms of knowledge into decision-making.

5.1.6 Theme 6: Natural Hazard Risk Management Benefits When All Forms of Knowledge are Shared and Exchanged Between All Stakeholders

Knowledge Sharing and Exchange was another theme identified when analyzing the key informants' interview transcripts. Knowledge sharing and exchange is the process by which knowledge is passed from one individual or organization to another. The Knowledge Sharing and Exchange theme focused on ideas such as: the sharing and exchanging of all forms of knowledge (e.g. natural science, social science, traditional ecological, Indigenous, local). Specifically, the Knowledge Sharing and Exchange theme focused on: who is sharing and exchanging knowledge, what knowledge is being shared and exchanged, why (or why not) knowledge is being shared and exchanged, in the greater Pinery Provincial Parke region. A summary of strengths, weaknesses, needs and opportunities is presented in *Table 14*.

Table 14 Theme 6: Summary of strengths, weaknesses, needs and opportunities for the Knowledge Sharing & Exchange theme.

Theme 6: Knowledge Sharing & Exchange
Strengths   • Knowledge sharing and exchange occurs within the greater Pinery Provincial Park region.   • Internal knowledge sharing and exchange was a strength identified by all key informants (i.e., within their respective organizations).   • Local provincial government affiliated key informants stated that their organization has formalized knowledge sharing agreements.   • All key informants identified natural science knowledge as the most common form of knowledge being shared and exchanged within their own organizational contexts.   ***Weaknesses***   • Public Health sector affiliated key informants noted that they are not included in the sharing or exchange of risk management knowledge, and specifically natural hazard risk management knowledge.   • A local provincial government affiliated key informant indicated that their organization has a working (versus reporting) relationship when it comes to external knowledge sharing and exchange in the region.   • Public Health sector affiliated key informants expressed that knowledge sharing and exchange with the greater Pinery Provincial Park region's senior population is a challenge.

- A regional provincial government affiliated key informant stated that the 2019 travel ban, imposed by the Ontario Government, inhibited knowledge sharing and exchange.
- Local provincial government affiliated key informants expressed that the process of knowledge sharing and exchange can impede the sharing of knowledge.
- Privacy concerns can cease the sharing and exchange of knowledge.
- A local provincial government affiliated key informant and a Public Health sector affiliated key informant stated that "knowledge is power," and not everyone is willing to share and exchange their knowledge.

Needs and Opportunities

- All key informants identified the need and opportunity to share and exchange knowledge in-person, as opposed to online.
- All key informants emphasised the need for researchers to report back on research findings, in a formal or informal manner.
- A Public Health sector affiliated key informant suggested adopting a story-telling approach when sharing and exchanging knowledge externally with the public.
- A municipal local government affiliated key informant identified a need to evaluate the effectiveness of knowledge sharing and exchange initiatives.
- Regional provincial government affiliated key informants need government-support to share and exchange social science knowledge and traditional ecological knowledge, Indigenous knowledge and other forms of local knowledge.

5.1.6.1 Strengths

Key informants identified various strengths related to the Knowledge Sharing and Exchange theme. The key informants' interviews provided sufficient examples to prove that knowledge sharing and exchange is occurring in the greater Pinery Provincial Park region. A local provincial government affiliated key informant stated:

> *"provincially we do share some things with/so there is some inner ministry kind of things now, especially with us out of Ministry of Natural Resources and Forestry now, where we have to work with them closely on some things. So there is some information that has to go back and forth between our Ministry and their Ministry, and the conservation authorities, and things like that" (P.G.L.2).*

A regional provincial government affiliated key informant was also able to provide evidence to support their organization's active participation in knowledge sharing and exchange efforts: *"from an organizational standpoint, our branch office in Peterborough would disseminate knowledge at a higher level to generally different levels of government or relating to our protocols and, any occurrences as well, like a summary of occurrences" (P.G.R.1).* Lastly, a municipal local government affiliated key informant explained that:

> *"we have an Association of Fire Chiefs and then I can draw upon all types of/of information. We meet fairly regularly and stuff, so we don't have to reinvent the wheel. There's similar circumstances, in similar places. And -you know, once again, drawing on that knowledge is makes things/life easier. And the fire service's, is/is an excellent-/we share everything. We steal from everybody. We share everything. There is no/nothing is sacred in our service" (L.G.M.2).*

The examples provided by the key informants illustrate that some knowledge sharing and exchange is occurring in the greater Pinery Provincial Park region.

While the key informant's interviews provided various examples to prove that knowledge sharing and exchange is occurring in the greater Pinery Provincial Park region, key informants repetitively identified internal, as opposed to external, knowledge sharing and exchange to be their greatest strength. Regional provincial government and local provincial government affiliated key informants spoke the most confidently of their internal knowledge sharing and exchange efforts. For example, a local provincial government affiliated key informant overtly stated: *"we share within the [regional provincial government] organization. Yes" (P.G.L.4).* Internal knowledge sharing and exchange is critical to the success of an organization; however, external knowledge sharing and exchange is critical to the success of the organization and greater region.

In addition, another local provincial government affiliated key informant discussed the existence of knowledge sharing agreements; moreover, proving to be a strength related to the Knowledge Sharing and Exchange theme: *"I know there are a few places where we have, information sharing agreements between a university and/and ourselves, or between us and a conservation authority, and that/there is some of that, that goes on" (P.G.L.2).* Formalizing knowledge sharing and exchange can yield favorable outcomes.

Not only did the key informant's interviews provide various sufficient examples to prove that knowledge sharing and exchange is occurring in the greater Pinery Provincial Park region, but key informants also elaborated on how exactly knowledge is shared and exchanged. A regional provincial government affiliated key informant claimed that: *"message[s] would come through more direct channels to park visitors such as like signage or, you know, sometimes we'll do newspaper ads or word of mouth communication depending on what it is, as we often have control of entries into parks, so we're able to provide that type of information" (P.G.R.1)*. A Public Health sector affiliated key informant volunteered that: *"there are couple local radio stations, which are helpful when they do an emergency alert over the radio station" (P.H.S.2)*. A municipal local government affiliated key informant also explained that social media is strategically utilized by their municipality to share and exchange knowledge:

> *"web presence: Facebook, Instagram, and I think that's all the municipality uses, from a/from a social media, but the/the very active, probably -you know, could you say we limit ourselves to -I'm going to say 2 or 3 posts a day, but they're preplanned, they're canned, they're ready to go, they're appropriate -you know, they're thought out. We have a proper communications person, that -you know, thinks out when you want to hear this, when you're going to meet your/your target launch, and we have a relatively okay following" (L.G.M.2).*

A local provincial government affiliated key informant also stated:

> *"I'm going to say- its either I pick up the phone… or send them an email saying this is what we're dealing with so and I guess then if I need assistance, they may come in or they may offer assistance… -it's shared -like documents are shared around, and-are we do get together meetings regularly, so if an incident happens here, we share those experiences with other park superintendents within the organization. And/and information is always flowing out" (P.G.L.3).*

Specific to natural hazard risk management, another local provincial government affiliated key informant explained that:

"wind events, which, you know, we do have, one example, years ago we worked with Environment Canada to develop up some fact sheets on severe weather and camping safety, which have proven to be very helpful. We post them throughout the park and on our websites. So that was a great partnership where we sort of went to the experts and said, 'What can you advise?' So what do you do in the event of a severe thunderstorm or high wind if you're outside without a building or vehicle or those kinds of things" (P.G.L.1).

Again, key informants illustrated that some knowledge sharing and exchange is occurring in the greater Pinery Provincial Park region, through the detailed examples provided.

Lastly, key informants unanimously agreed that natural science knowledge is the most common form of knowledge being shared and exchanged. A municipal local government affiliated key informant supported and provided an explanation for predominantly sharing and exchanging natural science knowledge: *"I think for the most part, scientific-based knowledge and stuff, is the easiest. It's the most acceptable. It's, the bureaucracy seems to work best on that" (L.G.M.2).* While the sharing and exchange of natural science knowledge is most common, it is important that *all* forms of knowledge are being shared and exchanged.

5.1.6.2 Weaknesses

Key informants identified numerous weaknesses related to the Knowledge Sharing and Exchange theme. Public Health sector affiliated key informants overwhelmingly expressed that they are not included in the sharing or exchange of risk management, and specifically natural hazard risk management knowledge. For example: *"I'd say at this point it's not done [knowledge is not disseminated to partners in the regions collaborative efforts to mitigate natural hazard risks]" (P.H.S.2).* It could be potentially disadvantageous for Public Health sector organizations not to be included in the sharing or exchange of risk management, and specifically natural hazard risk management knowledge, as the Public Health sector plays a critical role in the natural hazard risk response.

Another weakness related to knowledge sharing and exchange was identified by a local provincial government affiliated key informant who indicated that their organization has a working (versus reporting) relationship when it comes to external knowledge sharing and exchange, in the region: *"we work closely with all of these groups, closely and very regularly, but as for how do we share information, it's more of a working relationship as opposed to a reporting to relationship. We don't share much data*

with/with them" (P.G.L.4). Th local provincial government should prioritize the establishment of an external reporting relationship with stakeholders in the greater Pinery Provincial Park region.

Key informants also highlighted that the greater Pinery Provincial Park region's population is characterized by a considerable senior population. Knowledge sharing and exchange with the greater Pinery Provincial Park region's senior population was identified as a weakness; moreover, a Public Health sector affiliated key informant attempted to provide an explanation as to why this may be the case:

> *"I think because we have a large senior population, it's really hard to get them involved in new technology. So, you know, a lot of times we want to use email, we want to use social media to spread our message and to get input and so forth. But because of the population and demographics that we have here, we just can't do that. So that is a barrier for us" (P.H.S.3).*

The knowledge sharing and exchange barriers faced by senior populations need to be considered.

The 2019 travel ban imposed by the Ontario Government was also a weakness coded to the Knowledge Sharing and Exchange theme. A regional provincial government affiliated key informant stated that:

> *"this year [2019] there's been a restriction on travel, so we haven't been able to go to as many meetings as previously,… so there hasn't been as much of that the last year or two. So I think people are trying to shift to like webinars, things like that, but there isn't as much discussion involved" (P.G.R.2).*

Based on this finding, it could be determined that limiting the physical movement of individuals also limits the sharing and mobilization of knowledge.

Another weakness coded to the Knowledge Sharing and Exchange theme was that: *"it takes forever to get approvals to-to be able share that stuff [risk management knowledge]" (P.G.L.3).* The process of knowledge sharing and exchange can ultimately impede the sharing and exchange of knowledge.

Lastly, privacy was a weakness identified by key informants relevant to the Knowledge Sharing and Exchange theme. A regional local government affiliated key informant explained that, *"there are elements where information is sensitive and you/you need to think twice before you disseminate it" (L.G.R.1).* A regional provincial government affiliated key informant also echoed the: *"different privacy concerns" (P.G.R.1),* but added that there is a, *"hesitation [related to] sharing things with the government because, then it might become public knowledge" (P.G.R.1).* As such, privacy concerns can cease the sharing and exchange of knowledge.

A local provincial government affiliated key informant blatantly shared their opinion as to why they believe knowledge sharing and exchange is a weakness in the region:

> *"I would say that's the bottom line is people don't like to share. Knowledge is power, so they don't always like to share the information. I would say sometimes there's confidentiality, things that get in the way of being able to share, or other people don't want to share it because they think it's top secret and, 'If I give it to that person, they may tell somebody else, then it's not appropriate.' So I think that kind of stuff too happens a lot where it gets bottled up because they don't want to share" (P.G.L.2).*

Unfortunately, not all stakeholders believe that sharing and exchanging knowledge can be even more powerful than exclusively possessing knowledge.

5.1.6.3 Needs and Opportunities

Key informants identified needs and opportunities related to the Knowledge Sharing and Exchange theme. A need and opportunity to place importance on in-person knowledge sharing and exchange, was identified by the key informants. For example, a Public Health sector affiliated key informant noted that:

> *"we're finding people are getting over, inundated with emails and that you're not going to check websites and they're not gonna check blogs and you know, blogs are done, all that kind of stuff. You have to have face to face, and you have to have networking, and you have to know people that you're working with and trust the people that you're working with. So it really is about touching the people that are involved, navigating through the system together… networking, reaching out, familiarity, attending meetings- if they're held" (P.H.S.2).*

A municipal local government affiliated key informant supported this idea and suggested that: *" -quite honestly, just the/the/the/the formalization of knowledge sharing groups. So, for example, if we could sit down with parks on an annual basis and look at their emergency plans, look at ours, talk about issues" (L.G.M.2)*, would benefit knowledge sharing and exchange in the region. A regional local government affiliated key informant elaborated even further to suggest that, *"pooled knowledge is always/you're always more/you're always better equipped when/when your stakeholders are at the/at the same table and willing to share the same level of information that you're willing to share, just helps you understand each other's processes and hazards much better" (L.G.R.1)*. In today's increasingly online world, key informant's interview responses suggested that in-person knowledge sharing and exchange should remain valued and prioritized.

Reporting, whether formal or informal, was an identified knowledge sharing theme need and opportunity. A Public Health sector affiliated key informant explained that: *"I think it's honestly sharing the information. Right? Like a lot of times people do stuff and we never see the end result… We see that, oh, we have this great report. That's great. Checkbox- it's done, and then we don't see anything else from it. So it's about taking the information, actually doing something with it" (P.H.S.3).* A local provincial government affiliated key informant also agreed, noting that:

> *"from an academic side, you know, just appropriate reporting and sharing of knowledge. There is sort of a nuance where a lot of the people who work in parks, maybe not used to reading academic journals. And so it might require sort of some gray literature publications that come out of, primary literature" (P.G.L.1).*

Reporting research findings back to research participants, is an intentional act of knowledge mobilization.

A Public Health sector affiliated key informant suggested adopting a story-telling approach when sharing and exchanging knowledge externally with the public:

> *"when we speak to, like our physicians, evidence and facts is what speaks- right?! Whereas when we talk to the general public, we try to use storytelling, as more of an approach. So it's a little bit of both. Sometimes- again, people want to see both. Other people don't want to*

know the facts, they just want to know sort of the outcome or what's the story you're trying to tell. So again, it's depending on the audience that you're trying to meet with" (P.H.S.3).

The specific knowledge sharing and exchanging approach employed, should be strategically considerate of the individual or group receiving the knowledge.

The need to evaluate the effectiveness of knowledge sharing and exchange initiatives was identified by a municipal local government affiliated key informant:

"we're beginning/better at evaluating what we're/we're doing (education), some trying to get down to/to understanding how effective some of these things are and some things aren't very effective, but we still do them because they're easy. Some things are more effective, but they take a/a lot of work to do. So we're/we're becoming/we're catching up, with the industry of where we need to go" (L.G.M.2).

The effectiveness of knowledge sharing and exchange initiatives should be frequently, and critically reflected upon.

Lastly, while a regional provincial government affiliated key informant optimistically expressed: *"we are progressing quite a bit and I certainly like from 1996 or even, you know, 15 years ago, I've seen, like an exponential increase in how we're using traditional ecological knowledge and social science" (P.G.R.1),* support to share and exchange social science knowledge and traditional ecological knowledge, Indigenous knowledge and other forms of local knowledge, was a prominent need and opportunity identified after analysis of the key informant's interview transcripts. For example: *"support, certainly from like the, the provincial government" (P.G.R.1),* would improve the sharing and exchange of social science knowledge, traditional ecological knowledge, Indigenous knowledge or other forms of local knowledge. Another regional provincial government affiliated key informant also expressed that: *"things like traditional knowledge is a bit trickier, because we wouldn't want to overstep. So again, when we can share directly, something that someone else has put together, then we would definitely try to do that" (P.G.R.2).* The sharing and exchange of all forms of knowledge should be supported.

5.1.7 Theme 7: Proactive Planning is Critical to Successful Natural Hazard Risk Management

Planning was another theme identified when analyzing the key informant's interview transcripts. Planning is the process of outlining or developing an approach(es) to an anticipated event. The Planning

theme focused on ideas such as: which individuals and organizations are involved in natural hazard risk management planning, what the natural hazard risk management planning process entails, and how individuals and organizations go about proactively and reactively planning for natural hazard risks, in the greater Pinery Provincial Park region. A number of strengths, weaknesses, needs and opportunities were identified and discussed by the key informants when referencing the Planning theme, as summarized in *Table 15*.

Table 15 Theme 7: Summary of strengths, weaknesses, needs and opportunities for the Planning theme.

Theme 7: Planning
Strengths • A regional local government affiliated key informant and a municipal local government affiliated key informant stated that their organizations plan for specific natural hazards. • There is evidence that regular risk management planning meetings are occurring at the regional local level in the greater Pinery Provincial Park region. • Key informants stated their willingness to access and review existing plans when planning for natural hazard risks that pose a threat to the region. • Natural science is the main form of knowledge being accessed by the key informants when planning for natural hazard risks. ***Weaknesses*** • A municipal local government affiliated key informant expressed that there is a lack of knowledge surrounding the greater Pinery Provincial Park region's visitors, which; therefore, undermines any risk management, and specifically natural hazard risk management, planning initiatives. • Limited or absent natural hazard risk management planning has been undertaken by Public Health sector key informants and their organization. • Local provincial government affiliated key informants identified a lack of proactive natural hazard risk management planning. ***Needs and Opportunities*** • There is a need for a clear goal when planning and managing for natural hazard risks. • The unpredictable nature of climate change would suggest that Pinery Provincial Park needs to focus on proactive risk management planning and specifically on natural hazard risk management planning.

- A Public Health sector affiliated key informant expressed the need to plan with the region's unique demographic composition in mind (e.g., young visitors and senior residents).
- Public Health sector affiliated key informants need to be included in natural hazard risk management planning.

5.1.7.1 Strengths

Key informants identified various strengths related to the Planning theme. All-encompassing risk management and natural hazard risk management planning is important; however, planning for specific types of natural hazards ensures that the risk management responses are uniquely tailored. Wind-related events and tornadoes are natural hazards that require risk-specific management planning; the risk management response to a flood-event or a wildfire-event require a significantly different response in comparison to a wind-related event or tornado. A regional local government affiliated key informant stated that a:

> "*hazard plan (was developed) specifically for, tornadoes and in severe summer weather events because that is probably the highest ranking risk/well, it is the highest ranking risk for the municipality. So, we plan for those… In general, yes, we do. We/we make/we make plans for the hazards that we can prevent and mitigate and the ones that we can't prevent and mitigate and we prepare for" (L.G.R.1)*.

The regional local government's all-encompassing risk management planning efforts, are complimented with their risk-specific management planning efforts.

Additionally, there is evidence that regular risk management planning meetings are occurring at the regional local government-level, in the region. For example: *"the regional local government meets four or five times a year with the, with the, Emergency Management Coordinators of the local municipalities. We talk about different risks in the community, different initiatives to prepare, and planning against risks" (L.G.R.1),* was an excerpt, coded as a Planning theme strength, from a regional local government affiliated key informant's interview transcript.

When planning for natural hazard risks that pose a threat to the region, key informants stated their willingness to access and review existing plans. A regional local government affiliated key informant explained that,

"we're constantly looking at different appendices that will support our senior staff in dealing with an emergency. And one of our appendices is our/is our Hazard Identification and Risk Assessment [HIRA]. And that is evaluated every year by our Emergency Management Program Committee and to look at different risks in the community and make sure that we're still planning for the risks that pose the biggest threat" (L.G.R.1).

Natural hazard risk management planning should be in a continuously cycle of review and refinement.

Another strength identified by key informants related to the Planning theme was that natural science is the main form of knowledge being accessed when planning for natural hazard risks, *"I think it (natural science) plays a very relevant role, right? Because it helps, helps you to plan" (L.G.M.1)*. Natural science knowledge beneficially informs risk management planning efforts.

5.1.7.2 Weaknesses

Numerous weaknesses were coded to the Planning theme. When planning for natural hazard risks, it is important that all potential factors and scenarios are considered. When asked about planning in the region, a regional local government affiliated key informant expressed a significant concern: *"we don't even know who our visitors are" (L.G.M.2).* The lack of knowledge surrounding Pinery Provincial Park visitors undermines current risk management planning initiatives.

Another concerning weakness coded to the Planning theme was the limited or absent natural hazard risk management planning undertaken by Public Health sector affiliated key informants and their organizations. For example, a Public Health sector affiliated key informant stated: *"I would say that really we aren't doing it to mitigate natural disaster risk. I would say that's not been a focus at all- of this centre at all" (P.H.S.3)*. A Public Health sector affiliated key informant also expressed: *"as far as planning for the risk- we haven't gone to that level" (P.H.S.2).* Stakeholders with a role in natural hazard risk management in the region, specifically the Public Health sector stakeholders, are not participating or being encouraged to participate in natural hazard risk management planning; furthermore, in the case of a natural hazard event, negative outcomes are anticipated to result for the entire region.

The lack of proactive planning was yet another weakness coded to the Planning theme. One of the local provincial government affiliated key informants stated, *"I have been with you know parks for over*

30 years now so, an-you it seems that this organization or we/we/we are not proactive we are reactive, so if it happens then we can deal with it and ah ya we are very good at it" (P.G.L.3). All local provincial government affiliated key informants expressed confidence towards reactively responding to natural hazard risk events; however, proactively planning for natural hazard risks could significantly decrease or essentially eliminate the degree to which reactive response is required.

5.1.7.3 Needs and Opportunities

Key informants volunteered various needs and opportunities related to the Planning theme. The need for a clear goal when planning and managing for natural hazard risks was emphasized by the key informants:

> *"whenever you're doing your planning and management it is to have that clear goal or what are your objectives. And I think that's when you would tailor to what types of information that you would use to make your decisions or make your plans. So again, it's looking at what the evidence is, out there, how does it support what you're trying to do- exactly like what you're doing here. And moving forward with that" (P.H.S.3).*

A clear goal will not only guide natural hazard risk management planning, but it will hold those involved in natural hazard risk management planning accountable.

Additionally, the unpredictable nature of climate change would suggest the need for greater proactive risk management planning, and specifically proactive natural hazard risk management planning; however, an excerpt from a local provincial government affiliated key informant states that this is not the case:

> *"at, at our level, at the park, I'm not aware of anything that's being done to sort of assess it from- again, there is probably some reactive response…, but I'm not sure that that has gone into our planning at all. It would just be sort of that we might get more familiar with dealing with reacting to climate based issues? Because they are happening more frequently and so we change our response to/to match that need, but I'm not sure that we're doing it proactively" (P.G.L.1).*

Climate change has the potential to increase the occurrence and severity of such natural hazard events; moreover, proactive planning should be favoured over reactive response. Proactive planning efforts, specifically natural hazard risk management planning efforts, are needed in the greater Pinery Provincial Park region.

Public Health sector affiliated key informants addressed two main demographic groups: young visitors and senior residents, in their interviews. A Public Health sector affiliated key informant expressed the need to plan with the region's unique demographic composition in mind, for example:

> *"so when we are planning our- we'd have to do mock/mock codes. When we would be doing a mock 'code orange,' we would think about what kind of demographics would come into the hospital as a result of the injury. So we know that our area has a lot of seniors. So we talk about our/our long-term care homes. We would talk about- we know that there are -I'm not going to call them trailer parks, but res-, areas where there are mobile homes in/in small areas. we know/you know, that there are often a lot of young people in the Pinery or so, we would think about those kinds of things when we're thinking about our response. But as far as, planning for the risk- we haven't gone to that level" (P.H.S.2)*.

There is a need for natural hazard risk management planning to be reflective of the region's unique demographic composition.

As mentioned previously, interviews exposed a need for Public Health sector affiliated key informants to be included in natural hazard risk management planning*: "yeah, well, risk management, we do have- you know/like I say, we have frameworks, we have/we have, we have knowledge of mitigating all kinds of risks, especially with respect to healthcare, so we would be valuable in that capacity if they, if they wanted that" (P.H.S.2)*. It is likely that if a natural hazard wind-related event or tornado were to occur in the region, Public Health sector would be called upon to assist not only with medical care, but also with overall coordinated, regional response. There is a need and opportunity to include Public Health sector affiliated key informants in natural hazard risk management planning. Overall, various needs and opportunities were identified throughout the key informant's interviews, that were coded to the Planning theme.

5.1.8 Theme 8: Natural Hazard Risk Management Plans, Policies, and Regulations Should Be Available and Accessed

Plans, Policies and Regulations was yet another theme identified when analyzing the key informant's interview transcripts. Plans, policies, and regulations are deliberate proposals, guidelines, or rules that exist to achieve, guide or control something. The Plans, Policies, and Regulations theme focused on ideas such as: what formal documents inform and mobilize natural hazard risk management in the greater Pinery Provincial Park region. A summary of strengths, weaknesses, needs and opportunities is presented in *Table 16*.

Table 16 Theme 8: Summary of strengths, weaknesses, needs and opportunities for the Plans, Policies & Regulations theme.

Theme 8: Plans, Policies & Regulations
Strengths   • Plans, policies and regulations are available to and frequently accessed by all key informants when managing natural hazard risks.   • Key informants and their organizations are internally informing those with a role in risk management of the risk management plans, policies, and regulations in place.   ***Weaknesses***   • A local provincial government affiliated key informant notably expressed that they were unsure if their organization had a risk management plan.   • A Public Health sector affiliated key informant was aware of the potential natural hazard wind-related and tornado risks in the region; however, their organization's risk management plan did not reflect risk-specific risk management planning.   • Key informants expressed that risk management plans, policies and regulations, can restrict the ways natural hazard risks are managed.   ***Needs and Opportunities***   • Key informants identified a need to ensure that all organizations have a risk management plan and an opportunity to actively review such risk management plans to ensure they are inclusive of the most up-to-date information.   • Key informants need to clearly define the difference between a Risk Management Plan and an Emergency Management Plan; it was evident in the interviews that the difference between these two plans was unclear as the names were used interchangeably.

- Key informants not affiliated with regional provincial government or local provincial government, identified a need for Pinery Provincial Park to specifically share their Risk Management Plan with stakeholders in the region who have a role in risk management.
- Public Health sector affiliated key informants need to be included in the creation of and as stakeholders in regional risk management planning and plans.
- Local provincial government affiliated key informants identified a need to focus on creating plans that proactively address wind-related events and tornadoes, as such risks are predicted to increase in occurrence and severity because of climate change.
- Key informants need to ensure that all risk management plans not only address climate change but begin to incorporate strategic planning for the natural hazard risks that are expected to increase in occurrence and severity.

5.1.8.1 Strengths

Key informants identified various strengths related to the plans, policies and regulations theme. The interview transcripts provided extensive evidence of the numerous plans, policies and regulations available to and frequently accessed by the key informants, when managing natural hazard risks. For example, an 'other conservation agencies' affiliated key informant addressed the site-specific risk management plans that their organization creates: *"we create a plan for every one of our properties that we own, and that includes a review of/of what we call liabilities on our property" (O.C.A.2).* Additionally, a local provincial government affiliated key informant outlined the risk management policies that guide their organization:

> *" I would say most of the stuff that comes out of that is/is done in a policy procedure type manner. So if you were to/if we've deemed there's a certain thing that a/a/at risk hazard tree, then there's policy procedures about, 'You need to have a hazard tree assessment program in a way of dealing with this in your park. Our emergency management stuff, you have to have a site-specific Emergency Management Plan. These are the things it should include, this is how you go about doing it… There's specific policies, procedures onto: here's how it has to be, these are the things, there's like weekly checklists that the staff need to complete, those sorts of things" (P.G.L.2).*

Numerous plans, policies and regulations are available to and frequently accessed by the key informants, when managing natural hazard risks.

Key informants and their organizations are internally informing those with a role in risk management of the risk management plans, policies, and regulations, in place. A municipal local government affiliated key informant stated: *"on Wednesday [2019] I did an actual presentation on our plan to all staff, which is the first time I've done that. So they understand that the plan exists, that they're legislatively covered and how we would act in a certain response or situation" (L.G.M.1)*; furthermore, this excerpt was coded as a strength related to the plans, policies and regulations theme. In order to effectively manage natural hazard risks, stakeholders in the region ought to be aware of the plans, policies and regulations which inform and guide natural hazard risk management and their specific role a part of these natural hazard risk management plans, policies and regulations. Risk management response exercises, some of which were mandatory, were discussed by all key informants. For example, a municipal local government affiliated key informant indicated: *"there's mandatory exercises that you have to have every year, there's mandatory reporting- what's called a compliance tool, it's legislated- you have to report every year. So, no- these are the things that we're/we're working through" (L.G.M.1)*. A regional local government affiliated key informant also stated: *"every year the regional local government does an emergency management exercise and it's based on the hazards we've already identified. So we practice our response to different hazards" (L.G.R.1)*. It is not enough to have risk management plans, policies and regulations; moreover, stakeholders with a role in risk management should be well-versed on the plans, policies and regulations.

5.1.8.2 Weaknesses

Weaknesses were coded to the Plans, Policies, and Regulations theme, upon analysis of the key informant's interview transcripts. One of the most concerning weaknesses coded was related to the plans, policies and regulations theme. A local provincial government affiliated key informant expressed during their interview, that they were unsure if their organization had a risk management plan: *"I don't even know if we have one [Risk Management Plan]" (P.G.L.3)*. This was a concerning statement, as the key informants were specifically selected based on the main role they play in risk management, in the greater Pinery Provincial Park region.

Key informants were aware of the potential natural hazard wind-related and tornado risks in the region; however, most key informant's risk management plans were all-encompassing risk management plans, as opposed to risk-specific risk management plans. A Public Health sector affiliated key informant expressed*: "[pause] -I don't know" (P.H.S.4)*, when asked if their risk management plan specifically addressed wind-related events or tornadoes, "*I don't know because like wind isn't even one of them.*

Which it's interesting after talking to you guys, I thought we need a policy on where do we go in the building for tornado, which we don't have" (P.H.S.4). Risk management plans need to reflect risk-specific and all-encompassing risk management planning.

Another weakness identified by key informants, which was coded to the plans, policies and regulations theme was that risk management plans, policies and regulations can be restrictive. An regional provincial government affiliated key informant stated: *"and, another significant barrier is we are, required to abide by a lot of, legislation, policies and procedures that sometimes can be restrictive in terms of, you know, what we can [laugh] do and how we're able to do it" (P.G.R.1).* The restrictions that are put in place, have the potential to impair the effectiveness of such plans, policies, and regulations, *"and I think that people get caught up in some of their mandates that they have to have. So you have to have certain reporting at certain times, so people will push ahead to meet that deadline" (P.H.S.3)*. Plans, policies and regulations are being created to satisfy requirements, as opposed to addressing regional natural hazard risks with uniquely tailored responses. A regional local government affiliated key informant supported this statement: *"I think once you get into the business of/of compliance reporting to the province, you end up, if you're not careful, you can end up with municipalities that manage their program to meet compliance, rather than manage the program in the/for the best interest of the community" (L.G.R.1)*. The purpose of risk management plans, and specifically natural hazard risk management plans, is to proactively foresee potential risks and ensure comprehensive responses to such risks.

5.1.8.3 Needs and Opportunities

Key informants identified various needs and opportunities throughout their interviews, related to the Plans, Policies, and Regulations theme. While some key informants indicated that their organization's risk management plan had been created many years ago, an 'other conservation agencies' affiliated key informant stated: *"prior to two years ago [2017], there wasn't a formal [Risk Management] Plan" (O.C.A.1).* There is a need to ensure all organizations have a risk management plan: *"Well, we don't have a separate risk management plan. I would say it's that's rolled into our Stewardship Plan for each property" (O.C.A.2)*, and an opportunity to actively review these risk management plans to ensure they are inclusive of the most up-to-date information.

Key informants also exhibited great confusion surrounding the difference between a Risk Management Plan and an Emergency Management Plan. For example, a local provincial government affiliated key informant explained:

> *"see and/and to me an Emergency Plan is the/is the reactive things that we have and/and/and/and that. The Risk Management Plan on/to me on the other side, is kind of the/the assessment and: can we/what can we do to mitigate this? What can we do to put plans in place and proactive? So I would say they're/they're two different things, but I/I don't think that's necessarily the norm, the way people would/most of the field staff wouldn't think of it as that way, they're like, 'I have an Emergency Management Plan. This is how I deal with risks in my park…' Again, it's the/it's the risk management side of things that I think we struggle with a little bit to/to try to figure out that versus emergency management" (P.G.L.2).*

There is a need to clearly define the difference between a Risk Management Plan and an Emergency Management Plan; it was evident in the interviews that the difference between these two plans was unclear as the names were used interchangeably.

Key informants not affiliated with regional provincial government or local provincial government, identified a need for Pinery Provincial Park to specifically share their Risk Management Plan with stakeholders in the region who have a role in risk management:

> *"we're not aware of Pinery Provincial Parks Emergency Management Plan. Right? It's not in [the binder]. So it would be nice to know what's in their plan because guess what, we border them and you know, but right now there's a bit of a disconnect because they're here, we're all around them. We don't have their plan. I don't even think they have our plan, but they could access it if they needed it" (L.G.M.1).*

Additionally, a regional local government affiliated key informant highlighted the general need to more openly share risk management plans: *"I think just the general sharing of our Emergency Response Plan with local municipalities and with the province- that's a huge step" (L.G.R.1).* This need was further emphasized by a Public Health sector affiliated key informant: *"I would say that a great- is needing to know what everybody else's plans are. Like you're really- cause I could not tell you what EMS's plans are or what the municipality plans to do. I don't think those are shared widely with anybody" (P.H.S.3).*

Pinery Provincial Park is a significant entity within the greater Pinery Provincial Park region; moreover, they should share their Risk Management Plan with stakeholders in the region who have a role in risk management.

Not only did the key informants identify a need to share risk management plans, but to also include all stakeholders with a role in risk management in the region, in the creation of such risk management plans: *"but right now there are plans, but, we're not, I'm sure there are plans at municipalities, but they haven't reached out to us and we have reached out to them to be included" (P.H.S.2).* A Public Health sector affiliated key informant suggested:

> *"I think we need to together as a group and come up with/with an overall plan. And, I can certainly see that, the Pinery would- I can see their concern. It's a big park. It's huge. There aren't that many places for people to kind of hide. If there was a situation and then to have all those people into town at the same time. Yeah, there's gotta be a coordinated effort" (P.H.S.4).*

Based on this, it is clear that a wider group of stakeholders working in the greater Pinery Provincial Park region should be involved in creation of risk management plans.

Local provincial government affiliated key informants confidently stated that their plans favour reactive response: *"we do have excellent reaction-type plans to -if we get hit by a wind-event, here's some things we have to put in place, here's what we have to do" (P.G.L.2)*; however, if wind-related events and tornadoes are predicted to increase in occurrence and severity because of climate change, there is a need to focus on creating plans that proactively address these specific risks.

Lastly, throughout the interviews, it became evident that explicit mention and use of the term climate change in risk management plans was uncommon: *"the impacts of climate change? Not the- the plan specifically doesn't reference climate change as a/as a phenomenon, but the- I think the understanding of/of climate change is/is reflected in/in the risks that we identify and plan for each year" (L.G.R.1),* or inconsistent: *"yes, it [Risk Management Plan] does take into consideration the impacts of climate change" (P.G.R.1)*. A worthwhile addition to risk management plans would be to ensure that all plans not only address climate change, but begin to incorporate strategic planning for the natural hazard

risks that are expected to increase in occurrence and severity, as a result of climate change. Overall, key informants identified various need and opportunities related to the plans, policies and regulations theme.

5.1.9 Theme 9: Productive Relationships Advantageously Aid Natural Hazard Risk Management

Relationships was yet another theme identified when analyzing the key informant's interview transcripts. Relationships are connections between two or more individuals or organizations. The Relationships theme focused on ideas such as: what relationships do (or do not) exist, the formal and informal connections between individuals and organizations, how individuals and organizations regard and behave towards each other, and how relationships are established and maintained, in the greater Pinery Provincial Park region. A number of strengths, weaknesses, needs and opportunities were identified and discussed by the key informants when referencing the Relationships theme, as summarized in *Table 17*. A detailed summary of this theme follows.

Table 17 Theme 9: Summary of strengths, weaknesses, needs and opportunities for the Relationships theme.

Theme 9: Relationships
Strengths   • Regional provincial government and local provincial government affiliated key informants specifically indicated that internal relationships are strong.   • Regional provincial government and local provincial government affiliated key informants indicated that their organizations have a strong relationship with the public, and this strong relationship is exhibited through the public's trust.   ***Weaknesses***   • Regional provincial government and local provincial government affiliated key informants turnover of personnel negatively effects their organization's ability to establish and maintain relationships.   • Key informant's limited engagement with traditional ecological knowledge, Indigenous knowledge, and other forms of local knowledge, has resulted in an unsatisfactory relationship with local Indigenous communities.   • A local provincial government affiliated key informant expressed that their organization lacks a strong relationship with Parks Canada.   ***Needs and Opportunities***

- Key informants identified the need and various opportunities to establish more relationships within the region.
- Key informants identified the need to be open and transparent when attempting to establish and maintain relationships in the region.
- Key informants discussed the need to genuinely commit to establishing long-term relationships with the local Indigenous communities.

5.1.9.1 Strengths

Key informants discussed various strengths related to the Relationships theme throughout the interviews. Internal relationships were consistently strong amongst all key informants; however, of all the key informants, regional provincial government affiliated key informants provided the most consistent evidence of strong internal relationships. A regional provincial government affiliated key informant confidently emphasized: *"there is a very strong sort of family-based approach within this organization" (P.G.L.1).*

Regional provincial government and local provincial government affiliated key informants indicated that their organizations also have a strong relationship with the public, and this strong relationship is exhibited through the public's trust. A local provincial government affiliated key informant provided evidence to support the strong relationship their organization has with the public who visit their park:

> *"they/they trust us by re-/repeatedly entering the premises. The park users here currently today, have all been here before. If they didn't have a level of trust, that we would look after their safety of person and property, they would likely not return or they would likely make others aware that the park is unsafe or untrustworthy" (P.G.L.4).*

Another local provincial government affiliated key informant stated:

> *"I think they do think of us as a trustworthy organization. I mean, there's also other places where we're dealing with other stuff that would/they were like, 'No, you're the government, you're lying to us. This is…,' and that, but all in all, I would say -yeah. [The regional provincial government] is/has a/a/a good reputation outweigh, and just because of the type of*

business we're in, people are/they're generally happy to come on: holiday, and vacation, and spend their time with us, so you kind of naturally flow into that" (P.G.L.2).

Lastly, yet another local provincial government affiliated key informant also indicated that specific staff are tasked with ensuring strong relationships are established and maintained with the public. For example, *"it's a superintendent's responsibility to, establish a relationship and communicate with, local emergency services, municipalities, relating to operational aspects" (P.G.R.1).*

5.1.9.2 Weaknesses

While there were various strengths identified by the key informants relating to the Relationships theme, weaknesses were also identified. With respect to establishing and maintaining relationships, turnover of personnel was identified as a weakness related to the Relationships theme. For example, a local provincial government affiliated key informant stated:

"turnover of personnel… police [for] example, if the local Sergeant were to retire or move on, we may have an excellent working relationship with them along with the other staff. But when you/when personnel changes happen here at the park or with the local, group of some sort, takes a bit of time to form new relationships, to share that information in such an easy, smooth way" (P.G.L.4).

As such, it appears that the turnover of personnel disrupts the establishment and maintenance of relationships.

Additionally, the limited engagement with traditional ecological knowledge, Indigenous knowledge, and other forms of local knowledge, was another weakness related to the Relationships theme. Relationships with Indigenous communities can only be strengthened if stakeholders in the region engage and value traditional ecological knowledge, Indigenous knowledge, and other forms of local knowledge. A regional provincial government affiliated key informant suggested: *"I think in the traditional ecological knowledge, realm, in my experience, it's only really effective when you have a relationship with the community" (P.G.R.1).* A local provincial government affiliated key informant also stated: *"confounding issues that come up that strain relationships and make it more difficult to access some information. So it's very hard to be moving ahead on sort of Project A when Project C is/is in a,*

you know, point of conflict perhaps" (P.G.L.1). Genuine regional-efforts to engage with local Indigenous communities and their knowledge, need to be made to support strong relationships.

Lastly, a local provincial government affiliated key informant expressed: *"well, we don't have as strong of a relationship with Parks Canada, as we probably should" (P.G.R.2).* While the regional provincial government and the national government have their idiosyncrasies, both organizations share the similarity of managing protected areas. Natural hazards such as wind-related events and tornadoes are risks likely to occur in and effect both regional provincial government and national government properties. A local provincial government affiliated key informant indicated, in their interview, that there is a willingness to and, *"potential for us to share our sort of, you know, collective experiences of how we have managed to this point dealing with, scenarios where we have large levels of the public involved- at various times of the year" (P.G.L.1)*; moreover, establishing a relationship between these two organizations would promote knowledge mobilization and result in more informed and effective natural hazard risk management planning.

5.1.9.3 Needs and Opportunities

Key informants identified various needs and opportunities related to the Relationships theme. In general, key informants discussed the need and various opportunities to establish more relationships within the region. An 'other conservation agencies' affiliated key informant discussed the need to remain persistent when establishing a relationship with the local community. For example: *"for a year -say, so, I'm not expecting that we'll be fully integrated into every community group and understand all of the/the needs and able to tap into all of the knowledge that exists for possibly 5/10 years -who knows" (O.C.A.2).* A local provincial government affiliated key informant also stated: *"I used/we used to have a very sort of close relationship with the librarian for the Ministry of Natural Resources and Forestry and you know, we're, we're trying to reach out to the counterpart in our new Ministry Environment, Conservation and Parks, but just haven't built up that relationship and process quite as well yet" (P.G.L.1)*; moreover, this is an example of a relationship that needs to be established and fostered to ensure effective knowledge mobilization. Additionally, a Public Health sector affiliated key informant stated: *"I think that the parks [Pinery Provincial Park] need to reach out, and get to know their communities they serve" (P.H.S.4).* Pinery Provincial Park is a main stakeholder in the region; moreover, establishing a strong relationship with this stakeholder would promote the effective mobilization of natural hazard risk management knowledge in the region. The need and opportunity to establish

relationships with stakeholders who have a main role in natural hazard risk management in the region, was extensively discussed by many of the key informants.

In order to ensure relationships remain strong between the Public Health sector and the public, a Public Health sector affiliated key informant volunteered: *"well I think we try and have as many activities as we can where we are 'open door,' so that people can come and/and feel, you know, that they can participate" (P.H.S.4).* A local provincial government affiliated key informant also emphasized the importance of: *"continuing to be open and transparent with what we're doing, and why we're doing it" (P.G.L.2)*, when attempting to establish and maintain relationships in the region.

Lastly, key informants discussed the need to genuinely commit to establishing long-term relationships with the local Indigenous communities. For example, a local provincial government affiliated key informant supported this need by stating:

> *"I think that, it really, it's/it's a bit tricky, but it requires relationship building with specific [Indigenous] individuals in their communities, to build up a degree of trust where they feel comfortable sharing their knowledge. So that, you know, has, you know, taken decades of work by individuals in this park to sort of build-up that level of trust and then there's, you know, sharing of their knowledge. So that's a/a key sort of long-term commitment by [the regional provincial government] to be supportive of their community and to engage with them. There's certainly a lot more that can be done obviously, that we need to work on. But, yeah, I'd say that/that's a key thing. You know, just having us able to work with them over multiple iterations of this management process, they've sort of become more comfortable with us and have a better understanding of sort of how we operate this/this program and through that, you know, some information has flowed to us" (P.G.L.1).*

A genuine commitment to establishing and maintaining long-term relationships with the local Indigenous communities should therefore be a higher priority.

5.1.10 Theme 10: Availability of Resources and Capacity Determine the Success of Natural Hazard Risk Management

Resources and Capacity was another theme identified when analyzing the key informant's interview transcripts. Resources are defined as the assets available to an individual or organization to

allow for effective function, and capacity is defined as an individual's or organization's ability to do a certain thing. The Resources and Capacity theme focused on ideas such as: what resources are (or are not) available; what the capacity of individuals or organizations are (or are not), why resources and capacity are important to the success of natural hazard risk management. *Table 18* provides a summary of the strengths, weaknesses, needs and opportunities identified and discussed by the key informants with respect to Resources and Capacity.

Table 18 Theme 10: Summary of strengths, weaknesses, needs and opportunities for the Resources & Capacity theme.

Theme 10: Resources & Capacity
Strengths   • A local provincial government affiliated key informant stated that resources can be easily accessed from the public, due to the public's emotional attachment to the park.   • A regional provincial government affiliated key informant indicated that they are able to access credible sources of information with ease.   • A regional provincial government affiliated key informant indicated that their organization employs a large number of staff who possess and support the organization's large knowledge base.   • Adequate risk management training is available to all key informants and all other staff within their organizations.   ***Weaknesses***   • Key informant's organizations are fiscally constrained.   • Key informants do not have the necessary time to adequately manage natural hazard risks.   • Key informants, with the exception of the regional provincial government affiliated key informants, stated that their organization's limited staffing resources inhibit their ability to adequately manage natural hazard risks.   • A local provincial government affiliated key informant indicated that staffing fluctuations because of seasonal employment, has a direct effect on their organization's ability to adequately manage natural hazard risks.   • Regional provincial government affiliated key informants expressed that the employment of social scientists is non-existent or limited within their organization.   • A local provincial government affiliated key informant identified a lack of capacity to effectively use and manage social media.

- Key informants indicated that the local Indigenous communities do not have the sufficient resources or capacity to adequately participate in consultations.

Needs and Opportunities

- In order to improve knowledge sharing capacity, key informants identified a need to increase monetary resources.
- Key informants identified a need to increase staffing resources.
- Key informants emphasized the need and opportunity for more and continued staff training related to natural hazards and natural hazard risk management.
- Key informants identified a need and opportunity for resources that support the use of social science knowledge and traditional ecological knowledge, Indigenous knowledge and other forms of local knowledge.

5.1.10.1 Strengths

Strengths related to the Resources and Capacity theme were identified by the key informants. A local provincial government affiliated key informant stated that resources can be easily accessed from the public:

> *"I think it's also very helpful that, [the local provincial government] in particular and [the regional provincial government] in general are, significant areas from an emotional standpoint for a lot of people. So it's a common, and public resource that people care about. So it becomes easier to access resources to protect and operate these areas versus something that might be more of like a private interest that people may be less willing to participate in or allocate resources to" (P.G.R.1).*

This position suggests that public investment enables access to an alternative stream of resources.

Another strength related to the Resources and Capacity theme addresses the ease to access credible sources of information, such as journal articles. For example, a regional provincial government affiliated key informant indicated: *"we have a whole library and/and suite of resources for natural resource research and decision-making. We have a, ministerial library, we can access for that kind of information. -Yeah, we're very fortunate to have lots of resources" (P.G.R.2).* The ability to easily access credible sources of information enables evidence-based decision-making.

Another regional provincial government affiliated key informant indicated that their organization employs a large number of staff who possess and support the organization's large knowledge base:

> *"[the] biggest benefit [of] the regional provincial government is that we have a very large staff base in a very large land base and varying experiences to draw from… we have access to a lot of resources and we do have a lot of capacity in terms of staff. We have, biologists that not only work at the park, but also work in this office, as well as, planners that work in this office, land specialists, operations specialist as well. So, and naturalists and interpreters, so quite a robust complement… I think there is a conception- based on my experience, that the regional provincial government and the local provincial government in particular has a lot of that covered or has considered risk management" (P.G.R.1).*

Additionally, due to the large number of staff employed and knowledge base, this organization possesses the resources and capacity to internally manage natural hazard risks:

> *"Prior to that, another tornado- an F2, struck part of the park and hit the Grand Bend area. We treated it here locally in the park as a local issue. we looked after it ourselves- staff mobilized, dealt with the situation. We probably would have had 10,000 trees come down, many of which the size of this building or just a pile of sticks thrown in together. We had several of those large blow downs through the park. But we/we dealt with it fairly well" (P.G.L.4).*

Additionally, the credible knowledge that key informants contribute to their organization's knowledge base is a result of many years of service in their respective fields: *"just past experience, and its work experience, I have been with you know Parks for over 30 years now" (P.G.L.3).*

Another strength related to the Resources and Capacity theme was the adequate risk management training available to staff in the region. For example: *" training is continuously available for staff on/on, a/when a new hazard is identified, we share it with the regional office, they share with a branch office, and then that information is passed along to staff, in all areas" (P.G.L.4).* Additionally, a local provincial government affiliated key informant indicated that specialized training is also available to staff:

"I have been very fortunate in and is developing relationship with the local or Indigenous relationship, so and quite often I've already- people come to me cause of the training I've had, so I work with the Ontario Provincial Police [OPP] so that they have provincial liaison team, so I work with them a lot, I had- I've taken their courses and their training. So that's managing anything dealing with if it's an issue with Indigenous community, its considered high risk, and so like I said I've been fortunate to have had a lot of training with outside organizations and able to deal with that so, from time-to-time I will get called upon to help negotiate or talk" (P.G.L.3).

The importance placed on staff training is a strength related to the Resources and Capacity theme.

5.1.10.2 Weaknesses

Numerous weaknesses were coded to the Resources and Capacity theme. The most common Resources and Capacity theme weakness discussed by the key informants, was related to the lack of monetary funds. Key informants were quick to respond that their organizations are fiscally constrained: *"we're always a little bit fiscally constrained. So, there's certain things that, managers are/are very concerned about -you know, you can only do so much with the given budget that we have, but I would say in most cases were quite/and try to be proactive about, about risk and, and at handling risk, but it's a/it's a challenge in a big park" (P.G.R.2)*. Managing natural hazard risks requires consistent resourcing to propel and sustain such initiatives; however, an 'other conservation agencies' key informant stated:

"there's obviously cases where our properties are neighboring other conservation lands, and we'll work with those other and managers to make sure we're as coordinated as we can be. In practice, that can often be challenging because one year we will have resources, but they don't, and another year they'll have resources, but we don't" (O.C.A.2).

The resources dedicated to support such natural hazard risk management initiatives appear to be inconsistent over time.

Another equally discussed Resources and Capacity theme weakness was related to time. Key informants uniformly agreed: *"arguably, time might be our barrier" (O.C.A.2).* An 'other conservation agencies' affiliated key informant indicated: *"no one has time [laugh]. Everyone's busy. Everyone's*

trying to do the best they can" (O.C.A.2). A Public Health sector affiliated key informant also agreed, and stated:

> *"time… and resources. Like that, the actual having, we don't, for example, have a risk management staff member/person. I, it's on, it's off the side of everyone's desk… we have nobody that is 'risk manager.' Is small/very small organization only 19 bed [-], independent of no other, no independent of its of other partners. So, barrier is time and resources-and human resources" (P.H.S.2).*

Intentionally dedicating more time to natural hard risk management initiatives would benefit the greater Pinery Provincial Park region.

While a regional provincial government affiliated key informant stated that their organization has a large staff base, this was not echoed by all of the key informants interviewed. A municipal local government affiliated key informant stated: *"I am the only full-time employee, everybody else is volunteer" (L.G.M.2).* A Public Health sector affiliated key informant emphasized their organization's limited staffing resources and, therefore, limited capacity to adequately manage for natural hazard risks. As one respondent noted: *" I guess the only barrier sometimes is we're, we're a small organization. We have- I think we're just under 50 employees… and there's a small management team. We all wear-twenty different hats" (P.H.S.4).* Lastly, this staffing weakness was also discussed by an 'other conservation agencies' affiliated key informant:

> *"I'm sure they [risks] do [vary depending on the season], but we don't have the capacity to necessarily manage as precisely as you might hope for… we/we have/give-or-take two full-time conservation biologists that are responsible for all of our properties from Niagara to Pelee Island, so they can't be everywhere after everyone wind-event or after every ice storm or after every tree may or may not have fallen over" (O.C.A.2).*

Inadequate staffing directly impacts an organization's ability to manage natural hazard risks.

Staffing fluctuations due to seasonal employment was yet another weakness identified by a local provincial government affiliated key informant:

"I think the number one problem would be, resourcing. So there's just not enough of us employed for a long/long enough time period. A lot of our staff are seasonal because of that fact. We have some who stay with us for years and years, but others that are quite a femoral and move on to try and find more secure employment. And so there's a high degree of turnover and just, you know, having not/not having sort of a lot of human resources, means that we often are just sort of accomplishing the/the mandatory requirements to operate the park. And some of these things that we know are sort of, you know, in our best interest- don't always get the full time and resourcing that they deserve" (P.G.L.1).

Based on this perception, staffing fluctuations, due to seasonal employment, have the potential to negatively impact an organization's ability to manage natural hard risks.

Another weakness related to staffing resources and capacity was the non-existent or limited employment of social scientists. For example, a regional provincial government affiliated key informant stated: *"unfortunately we don't tend to have too many social science experts around in our/in the park" (P.G.R.2).* If social scientists are not being employed, it can be assumed that social science knowledge is not being adequately accessed or mobilized. A regional provincial government affiliated key informant supported this assumption: *"social science information that you mentioned. It/because it's so dynamic and we don't have the type of dedicated resources that we do for like the other sciences in many cases, that it's one of the bigger gaps that comes to mind" (P.G.R.1).* Based on this, we can assume that if social scientists are not being employed within an organization that social science knowledge is not being adequately accessed and used to inform decisions.

The capacity to effectively use and manage social media was another weakness related to the Resources and Capacity theme. For example, a local provincial government affiliated key informant stated: *"we are active on a number of platforms and to be honest, this is an area that I personally feel a lot of, risk pers- like personal and so, organizational liability risk because we don't have the resourcing to be able to consistently respond and share information [on social media] about risk" (P.G.L.1).* If the necessary resources (e.g., monetary funds, time, staffing, etc.) are allocated, social media can be an effective knowledge mobilization tool.

Lastly, key informants indicated that the local Indigenous communities do not have the sufficient resources or capacity to adequately participate in consultations. For example, a municipal local government affiliated key informant stated:

> *"quite honestly, First Nations communities are so fricking consulted on everything… they actually have a capacity issue and can't actually be consulted. So while all of us government agencies, and I'm sure parks are the same -though I don't know that -you know, we reach out and we do our 'consultation' with them. It's not true consultation because with all three levels of government consulting on, there's no capacity there. There's not the/the ability to actually, for them to meaningfully think of" (L.G.M.2).*

An 'other conservation agencies' affiliated key informant also discussed the local Indigenous community's limited resources and capacity: "*I think about our relationships with our local, we're lucky that we have the Kettle and Stony Point First Nations nearby. And the challenge is their capacity to get involved with things that really aren't of their core mandate or interests. Like they have so much on their plate as a First Nations community" (O.C.A.1).* While local Indigenous communities may be invited to participate in consultations, it appears that there may be a lack of resources and capacity for effective engagement.

5.1.10.3 Needs and Opportunities

Key informants passionately discussed and provided examples of various needs and opportunities related to the Resources and Capacity theme. A need and opportunity related to the Resources and Capacity theme addressed the need for more monetary support: *"well it's kind of a boring copout answer, but with more money, and therefore, more stuff, we can always do better jobs" (O.C.A.2).* A local provincial government affiliated key informant specifically reflected on how the increase of monetary resources would greatly benefit knowledge sharing capacity:

> *"a lot of the staff are retiring now so we are losing that knowledge, so/so we are trying to get it- to get it documented, so write down what they know and- past history that sort of stuff so it's always available to future managers coming in… it's not always possible cause of financial reasons were if your bringing somebody else- their replacement to work side-by-side, but usually it's because of financial reasons their out and their replacement starts the*

next day so, so and that's where the documentation comes in then- because they gotta sit there and read and learn it" (P.G.L.3).

Retaining knowledge should be equally as important as creating and mobilizing knowledge; moreover, monetary funds should be allocated accordingly.

The need and opportunity for more staffing was addressed by the key informants, during their interviews, in relation to the Resources and Capacity theme. An 'other conservation agencies' affiliated key informant identified a benefit to be yielded from increased staffing resources:

"because we're so short staffed, we can't be fully integrated into every layer of society or communities, in which we're working. And we're slowly getting better at that, we used to be quite centralized and now we've got staff spread out across the province a little bit better. So we're much better able to take part in local events that are run by other organizations and things, to better understand the needs of communities" (O.C.A.2).

A local provincial government affiliated key informant also illustrated their organization's seasonal staffing fluctuations:

"we've had one tornado event in my time here in this park that was obviously, it/it was in, I think it was July… So there's certainly variability and our ability to respond because our staffing levels fluctuate so much over the course of a year. Is/is drastically different. So in the summertime we tend to have a lot of resources, but we also have a lot of public. In the winter time, we tend to be a lot lighter on staffing resources but have fewer visitors in the park" (P.G.L.1).

A consistent staffing capacity is critical when managing for and responding to natural hazard risks, that are predicted to increase in occurrence and severity, because of climate change.

Additionally, key informants emphasized the need and opportunity for more and continued staff training related to natural hazards and natural hazard risk management. For example, a local provincial government affiliated key informant stated: *"I think internally for us more training and, equipment for staff would be really helpful so that we can know how to respond, when to respond, all those kinds of*

things" (P.G.L.1). An 'other conservation agencies' affiliated key informant specifically identified a need for a,

> *"forum, for risk management education and training and upgrading and things like that. The/the challenge that I find, is that there ar-/there are companies out there that sell those services and I need to be able to weigh what services are, -you know, how are they accredited to provide those services? … I think there's an opportunity there to/to, advance that further" (O.C.A.1).*

Stakeholders and organizations with a role in natural hazard risk management, in the greater Pinery Provincial Park region, should invest in more and continued staff training related to natural hazards and natural hazard risk management.

Related to the Resources and Capacity theme, key informants identified a need and opportunity for resources that support the use of social science knowledge and traditional ecological knowledge, Indigenous knowledge and other forms of local knowledge. Optimistically; however, an 'other conservation agencies' affiliated key informant reflected: *"I can't see of any great barriers [of more fully integrating social science, traditional ecological knowledge, Indigenous knowledge or other forms of local knowledge, into parks planning and management] besides capacity to do it" (O.C.A.1).* The various needs and opportunities related to the Resources and Capacity theme, identified upon analysis of the interview transcripts, optimistically suggest a future of effective natural hazard risks management in the region.

5.1.11 Theme 11: Natural Hazard Risk Management is Everyone's Responsibility

Responsibility was a theme identified when analyzing the key informant's interview transcripts. Responsibility is the state of being accountable for something. The Responsibility theme focused on ideas such as: who is responsible for natural hazard risk management, why it is important that all individuals and organizations take responsibility for natural hazard risk management, and how responsibility related to natural hazard risk management is determined, in the greater Pinery Provincial Park region. A number of strengths, weaknesses, needs and opportunities were identified and discussed by the key informants when referencing the Responsibility theme, as summarized in *Table 19*.

Table 19 Theme 11: Summary of strengths, weaknesses, needs and opportunities for the Responsibility theme.

Theme 11: Responsibility
Strengths • Key informants are responsible for managing risks. • Key informants were able to identify various personnel, positions, and organizations, responsible for risk management, and specifically natural hazard risk management, in the region. • Reinforced by all key informants was the idea that everyone has a role and responsibility in risk management. • A municipal local government affiliated key informant discussed their organization's responsibility to educate the public on risks, in the region. ***Weaknesses*** • An 'other conservation agencies' affiliated key informant provided limited evidence to suggest that the public is being warned specifically of natural hazard risks. • A local provincial government affiliated key informant expressed that responsibility surrounding risk management should be shared with the public; however, this shared responsibility should not translate into negligent or laissez faire risk management by Pinery Provincial Park. ***Needs and Opportunities*** • Local provincial government affiliated key informants identified a need to continue taking responsibility to proactively and externally communicate risks, specifically natural hazard risks, that have the potential to occur in the region. • An 'other conservation agencies' affiliated key informant passionately expressed a need for the public to take responsibility to educate themselves on the known risks, specifically natural hazard risks, prior to visiting the region. • An 'other conservation agencies' affiliated key informant identified a need to communicate risks, and specifically natural hazard risks, to volunteers.

5.1.11.1 Strengths

The key informants provided numerous examples of strengths related to the Responsibility theme. There was an apparent responsibility, held by key informants, to manage risks. A regional provincial government affiliated key informant elaborated on their personally, specific role in risk management:

"it comes down to what level of risk am I willing to accept, or my boss willing to accept on, on behalf of [regional provincial government], to say, 'I'm comfortable with that.' I can defend that to the director or to the premier, and say, 'This was my rationale and I'm good with that,' so that's more the role that I would play in that is/is, yes -I'm comfortable when they come and say this is what we're going to do and -yeah, I'm comfortable with that level of risk" (P.G.L.2).

A local provincial government affiliated key informant also provided a detailed example of the level of responsibility assumed when managing for natural hazard risks:

"I oversee the hazard tree management program throughout the park. There are over +1000 campsites that people camp at, each year. We have an arborist inspection of each campsite and the trees surrounding the campsite, essentially looking at a one tree distance away from campsites. Any known hazardous trees, we close the campsite if we need to, or we use the norm/more common approach: we have the tree removed. We/we'd cut the tree down- do the tree cleanup, so that the area's safe. We document those inspections, even if there's- front campsite number #722, and there is no hazards, we document: time, day, person who inspected it, and then we have our park staff continuously inspecting trees. I oversee that to ensure that it's done in a reasonable way to manage general liability. If a park user informs us of a hazard tree, we will have knowledgeable and capable staff go down, inspect the tree and make a determination as to whether or not it's a hazard, whether or not it should be cut down, whether or not they [park user] need move off of that campsite right/right away or whether they may be able to remain. I make the decision if/if it's determined they must move, then they must/they must remove that/from that campsite" (P.G.L.4).

The detailed examples provided above suggest that key informants, specifically regional provincial government and local provincial government affiliated key informants, in the greater Pinery Provincial Park region, do take responsibility to manage risks.

Key informants were able to identify various personnel, positions, and organizations, responsible for risk management, and specifically natural hazard risk management, in the region. For example, a municipal local government affiliated key informant explained that at, *"the regional*

local government-level, it [risk management] is a full-time responsibility" (L.G.M.2). A local provincial government affiliated key informant identified organizations responsible for risk management, who would assist the region in the event of a natural hazard risk:

> *"outside of the park- if it were to be a severe emergency, that's Emergency Management Ontario. They would/they would mobilize and they are in charge. They would become in charge of this park as well, if there was a/a serious enough emergency, that local people couldn't handle themselves. In a situation that's not so severe, we worked with EMS on almost a daily basis, not so much this time of year, through the four months of the summer, we work with EMS almost daily, the volu/the local volunteer firefighter crews are in here regularly. We have an Emergency Response System that is well practiced, well utilized, and we have experienced staff that can lead through an emergency quite well. If/if we cannot, then the OPP [Ontario Provincial Police] would be brought in to lead it on our behalf. That would be a regional wide emergency on a local issue" (P.G.L.4).*

While the degree of responsibility for managing risks may vary depending on the key informant, all key informants should be responsible for being able to identify various personnel, positions, and organizations, responsible for risk management, and specifically natural hazard risk management, in the greater Pinery Provincial Park region.

The idea that everyone has a role and responsibility in risk management was reinforced by all key informants. A Public Health sector affiliated key informant stated:

> *"we do stress that it's everyone's responsibility in the organization to know what, at least what we know and what we have, in place [concerning risk management]. It's the responsibility to know it and we can educate and do education and hold, you know, quizzes and things like that, so that they're keeping it in their mind as much as they can" (P.H.S.2).*

A local provincial government affiliated key informant also stated: *"park staff are informed that if they become aware of a hazard, that they must inform their supervisor… The supervisor's aware they need to have that addressed. So there is a small reporting system in place, and then there's- for higher level staff, they need to be aware of the overall impact and how to address it" (P.G.L.4).* Everyone has a role and responsibility in risk management.

While everyone has a role and responsibility in risk management, there is a responsibility to educate. For example, a municipal local government affiliated key informant stated: *"we have a responsibility under our plan to engage the public and provide them with information. Educate, you know, trainings internal, it's legislated as well" (L.G.M.1).* Stakeholders and organizations with a role in risk management, specifically natural hazard risk management, should take on a greater role in educating the public on risks that may be encountered in the greater Pinery Provincial Park region.

5.1.11.2 Weaknesses

Only a few weaknesses were coded to the Responsibility theme. An 'other conservation agencies' affiliated key informant stated: *"in terms of Nature Conservancy or Lambton Wildlife or ourselves, we don't really do anything to say: if it's windy, don't come in our property- sort of thing -you know" (O.C.A.2)*; furthermore, this statement was coded as a weakness relevant to the Responsibility theme. While an 'other conservation agencies' affiliated key informant did mention that signage is posted if a trail is closed or maintenance work is actively occurring, there was limited evidence to suggest that users were being warned specifically of natural hazard risks.

The second weakness coded to the Responsibility theme was volunteered by a local provincial government affiliated key informant:

> *"I think so. I think that a lot of people come into parks and they have an expectation that a park ranger- man or woman, will come and rescue them if they have trouble. I struggle with this a little bit because it's, I don't think we always can live up to that expectation and I'm not sure that we should. I think that a lot of people go out into areas maybe a little bit, you know, ill-prepared and not equipped to deal with situations and maybe rely too heavily on, park employees to come to their rescue. So, you know, do we have appropriate resources to deal with every situation? No, certainly not" (P.G.L.1).*

While everyone has a role and responsibility in risk management, key informants and their organizations should ensure that this shared responsibility does not translate into negligent or laissez faire risk management.

5.1.11.3 Needs and Opportunities

Key informants discussed various needs and opportunities related to the Responsibility theme. There is a need to continue taking responsibility to proactively and externally communicate risks, specifically natural hazard risks, that could be encountered in the region. Because risks cannot be entirely eliminated, it is the responsibility of those key informants, their organizations, in addition to other stakeholders in the region with a main role in risk management, to ensure that probable risks are known. For example, a local provincial government affiliated key informant explained:

> *"on a minor scale, like the/the parks are always everyday printing off the weather. If there's special weather reports that are coming up, there/they try to make sure people are aware in their regular duties. We don't go out of our way to promote that or drive around with a loud speaker or anything, but they do post that information. They do when you check into pick up your permit, they'll/they'll tell you, 'Just, oh- by the way, there's a severe storm warning out for today'" (P.G.L.2).*

This need and opportunity was similarly echoed by another local provincial government affiliated key informant:

> *"continued proactive, hazard mitigation and communicating of hazards. Some of the hazards cannot be removed. There is a shared responsibility to take care of themselves. They are camping in a forest, they accept some of that risk them self. We accept some of that risk on their behalf by taking reasonable approaches to protect their safety of person and property" (P.G.L.4).*

Stakeholders and organizations with a role in risk management, specifically natural hazard risk management, should continue taking responsibility to proactively and externally communicate risks that could be encountered in the greater Pinery Provincial Park region.

An 'other conservation agencies' affiliated key informant passionately stated in their interview that: *"I want to get this in here, the whole challenge is, of, people accepting responsibility and to educate themselves as they go onto a piece of property" (O.C.A.2).* There is a need for the public to take responsibility to educate themselves on the known risks, specifically natural hazard risks, prior to visiting the region.

Communicating risks to volunteers was another need and opportunity coded to the Responsibility theme. For example, an 'other conservation agencies' affiliated key informant stated: *"another form of risk management, is us trying to work out what do we need to do in terms of due diligence to make sure that these volunteers are working safely on our property, to create a trail for visitors -to our property. So it has this whole layering of/of liability concern that one might have" (O.C.A.2).* While volunteers possess the potential to alleviate organization's responsibilities related to natural hazard risk management, the responsibility changes focus to prioritize volunteer safety when managing such risks.

5.1.12 Theme 12: Natural Hazard Risk Monitoring and Evaluation Informs Management, Especially in the Face of Climate Change

Risk Monitoring and Evaluation theme was a theme identified when analyzing the key informant's interview transcripts. Risk monitoring and evaluation is the act of observing and assessing something over a period of time. The Risk Monitoring and Evaluation theme focused on ideas such as: how natural hazard risks have and can be monitored and evaluated, and why it is ever more important to monitor and evaluate natural hazard risks in an era of rapid climate change. Climate change has reinforced the importance of risk monitoring and evaluation: *"I'm not a meteorologist, but just looking at this sort of trends during my time of working and living in this area. You know, that we seem to be featured in/in severe weather events relatively commonly" (P.G.L.1)*, when attempting to manage natural hazard risks, in the greater Pinery Provincial Park region. Strengths, weaknesses, needs and opportunities were coded to the Risk Monitoring and Evaluation theme, as summarized in *Table 20.*

Table 20 Theme 12: Summary of strengths, weaknesses, needs and opportunities for the Risk Monitoring & Evaluation theme.

Theme 12: Risk Monitoring & Evaluation
Strengths   • Key informants, with the exception of Public Health sector affiliated key informants, monitor and evaluate properties regularly, specifically after natural hazard risk events.   • The public participates in some risk monitoring efforts in the region.   • Key informants, with the exception of Public Health sector affiliated key informants, indicated that some data is available to monitor and evaluate natural hazard risks.

- Hazard tree monitoring and evaluation is at the forefront of natural hazard risk management, in the greater Pinery Provincial Park region.

Weaknesses

- A local provincial government affiliated key informant discussed personal hesitancy to proactively alert staff of natural hazard risks, despite access to adequate monitoring and evaluation resources.
- The data is not always available to reference for every specific risk-event, that occurs in the region.

Needs and Opportunities

- Inconsistent responses from the key informants supported a need and opportunity to acquire more data, and specifically data related to natural hazard risks.
- A local provincial government affiliated key informant identified forecasting as a need and opportunity to assist natural hazard risk management monitoring and evaluation efforts.
- Key informants identified the need to consider population fluctuation (changes in the number of visitors coming in the summer months) when monitoring and evaluating natural hazard risks.
- A local provincial government affiliated key informant identified an opportunity to use their camping registration system data to aid natural hazard risk monitoring and evaluation efforts.
- Key informants identified a need to identify natural hazard risk events that have occurred in other regions and analyze the responses of the organizations who have been affected.

5.1.12.1 Strengths

Key informants discussed numerous strengths that were coded to the Risk Monitoring and Evaluation theme. It was evident during the interviews and upon analysis of the transcripts, that monitoring and evaluating properties regularly, specifically after natural hazard risk events, was a common risk management practice in the greater Pinery Provincial Park region. An 'other conservation agencies' affiliated key informant stated:

> *"we commit to monitoring our properties from a safety perspective… we do commit to checking up on trail safety, particularly after some kind of relatively unusual weather event. So, in Spring when our field staff get back out, then obviously we're expecting to come across damage from Winter weather and that kind of stuff. And some more like we have, you know, a colossal thunderstorm or some kind of unusual weather event during the growing season, then*

we'll do our best to get out shortly after that as we can. We also rely on the public to let us know if they come across a problem on our properties" (O.C.A.2).

An 'other conservation agencies' affiliated key informant also explained their organization's risk management monitoring and evaluation efforts:

"*climate change has been a factor within that -sort of thing as/as we have changed. So/so that has increased our risk inspections as well… as our rainfall patterns are changing,… the inspections… have had to change. For example, the/the damage that flooding can do, -that we now get Winter rains. Whereas before I would say that, 'Okay. This trail at Bannockburn [Conservation Area] for example, that trail is basically going to be the same throughout the Winter.' But now if I get Winter rains, and we get the February rains, in that I need to inspect that after a February rain because there can be damage to the trails and to the structures and things like that" (O.C.A.1).*

Additionally, a regional provincial government affiliated key informants illustrated their organization's dedication to natural hazard risk management monitoring and evaluation. For example: *"we participate in monitoring efforts" (P.G.R.2),* and, *"so park staff, do daily checks of the park in terms of regular patrols, whether it's for enforcement or maintenance" (P.G.R.1).* This suggests that dedication to natural hazard risk management monitoring and evaluation helps enables evidence-based decision-making.

Another strength related to the Risk Monitoring and Evaluation theme was the public's participation in monitoring efforts, that then initiate evaluation efforts by key informants, their organizations, in addition to other stakeholders in the region with a main role in risk management. A local provincial government affiliated key informant discussed a project that was implemented:

"I implemented a project here called the Photomon Project, which is a long-term citizen science based photographic monitoring of environment. So there's posts throughout the park and the public, participates by snapping pictures and submitting them to us. And so that would allow us to document photographically document change in the environment, which may potentially one day play a role in how we might respond or you know, being able to sort of assess changes… that resource is meant to try and equip, you know, us today, but really future managers with a dataset of observation so they can see what the park was like at this time period and be able to compare and contrast that in the future" (P.G.L.1).

When public participation is enlisted in risk monitoring and evaluation efforts, data voids and deficiencies can be improved, and existing data sets can be complimented and grown, all with minimal strain on an organization's resources.

The availability of data, that can be used to monitor and evaluate natural hazard risks, was discussed as a strength by some key informants related to the Risk Monitoring and Evaluation theme. A regional provincial government affiliated key informant confidently stated that: *"we have a, a myriad of data from other parks… throughout the province and specifically throughout this region" (P.G.R.1). "So I think for us it's a/as technology advances in terms of computer technology and GPS and all that sort of stuff, that's made things a lot easier to log where hazards are" (O.C.A.1),* was an excerpt from an 'other conservation agencies' affiliated key informant's interview transcript; moreover, the availability of data in combination with new technologies, has significantly strengthened the greater Pinery Provincial Park region's ability to monitor and evaluate natural hazard risks.

Lastly, hazard tree monitoring and evaluation is at the forefront of natural hazard risk management, in the greater Pinery Provincial Park region. For example: *"a big part of risk management inspections would be identifying hazard trees, that are close to the trails and then cutting down those hazard trees. So that's, we don't cut down live trees and we realized live trees can fall during a tornado too" (O.C.A.1).* A local provincial government affiliated key informant and an 'other conservation agencies' affiliated key informant also discussed the monitoring and evaluation surrounding hazard tree risk management: *"certainly there's stuff like ongoing hazard tree assessment. So that happens on kind of a year-round like routine basis that if there are trees that are deemed to be at risk of/of coming down or they look unhealthy, then that would be something that's done on a routine basis" (P.G.L.1),* and,

> *"I mean, if we find a/again to focus on the wind thing, if we find a hazard tree, then we'll find the safest way to deal with that hazard. And if that creates another hazard, then we'll deal with that, as well. So you take a tree down, that pulls another one over, then we'll deal with that too… if we see a forest that has a high Ash component, or soon a high Beech component, or a high component of other trees are about to die, then we'll either commit to monitoring it more frequently until a point where we have to decide to close it, or hire a contractor to come in and take out the things that are obviously hazardous" (O.C.A.2).*

Hazard tree monitoring and evaluation is broadly at the forefront of natural hazard risk management in the greater Pinery Provincial Park region.

5.1.12.2 Weaknesses

A limited number of weaknesses were coded to the Risk Monitoring and Evaluation theme. A local provincial government affiliated key informant discussed the hesitancy to proactively alert staff of natural hazard risks, despite access to adequate monitoring and evaluation resources. For example: *"when the tornado hit here, I happened to be at my residence that evening, but I was tracking the weather situation. I had staff here and was getting updates and I sent out a notice that arrived basically at the same time as the tornado hitting. And there was some negative pushback saying, 'Well thanks for the notice, but it just happened'" (P.G.L.1).* Confidence accessing and interpreting natural hazard risk monitoring and evaluation information, is anticipated to decrease key informant's hesitancy around proactively alerting staff of natural hazard risks.

While the availability of data, that can be used to monitor and evaluate natural hazard risks, was discussed as a strength by some key informants, related to the Risk Monitoring and Evaluation theme, it was also discussed as a weakness by other key informants. An 'other conservation agencies' affiliated key informant explained that their organization has recently started to collect user data; however, the collection of risk-related data, specifically natural hazard risk data, has not yet been explored:

> *"I think the answer is probably not at present... we are just dabbling in collecting any data at all, on people visiting our properties. We have some trail counters up in a couple of places, so we're starting to understand -you know, how many people actually go there… I know there's a bunch of apps that are more specific to: trails, and trail use, and hiking groups, that we should be tapping into, to get exactly that kind of information" (O.C.A.2).*

When discussing a recent (2019) wind-related erosion event, a local provincial government affiliated key informant discussed how available data informed management decision: *"we were able to look at things like, erosion levels of so many meters/per year is what was expected, and we're seeing far in excess of that. We've got a bigger problem, we need to readjust the way we've been thinking about this, and/and that's, but so those came from engineering reports and things like that. So I think we do use that kind of data when it's available" (P.G.L.2)*; however, it was also mentioned that data is not always available to reference for every risk-event: *"for some scenarios, that stuff's just not there" (P.G.L.2).* Data is not

always available to reference for every specific risk-event, that occurs in the greater Pinery Provincial Park region.

5.1.12.3 Needs and Opportunities

Key informants were able to discuss many needs and opportunities related to the Risk Monitoring and Evaluation theme. Inconsistent responses from the key informants supported a need and opportunity to acquire more data, and specifically data related to natural hazard risks: *"I would say just any continual improvements in information that's/that's out/that's available on/on hazards and the impacts they could have on us" (O.C.A.1).* A local provincial government affiliated key informant expressed that: *"I would love to be able to survey park users and say, 'How would you want to be notified if there was this severe wind event happening?'" (P.G.L.1).* Another local provincial government affiliated key informant volunteered the idea of having,

> *"a data base available where everybody has access to it and they could input it- ya well I'm trying to think we're trying to get into—I sat on the regional provincial government Health and Safety committee and-and so when incidents happen, it's all recorded on paper, but I always say there should be a data base we can go in and just key that stuff in and then the stats are collected and then complied" (P.G.L.3).*

Maintaining data is equally as important as acquiring data: *"I think you're always as good as your data, right? So if your data's not maintained or kept up to date, then you risk somebody falling through the cracks. And that's one of the things that/that still has to be ironed out" (L.G.R.1).* Acquiring new data and maintaining existing data would better inform natural hazard risk monitoring and evaluation efforts in the region.

Another need and opportunity coded to the Risk Monitoring and Evaluation theme placed emphasis on forecasting. A local provincial government affiliated key informant suggested:

> *"forecasting probably would be a key one because we, you know, we have a, you know, situation here where we have potentially 10 to 12,000 people in this park. And sometimes, we're finding out about risk as it's happening… so knowing further in advance, that there's going to be an issue, would really help us to be able to better prepare,… be better at disseminating that inf/information. You know, so the ability to share alerts coming from*

experts within, you know, Environment Canada or you know, other weather agencies, faster and more effectively. But just, I know it's easy to say, hard to do, but having more advanced knowledge and forecasting saying there's heightened risk, would allow us to do a better job" (P.G.L.1).

Forecasting abilities to assist natural hazard risk management monitoring and evaluation efforts should be prioritized.

Key informants also identified the need to consider population fluctuation when monitoring and evaluating natural hazard risks. For example:

"well, summertime, the population of the/of our area including/which is in part due to the hiring, swells by thousands. So the more people you have in a condensed area, the worse, those/those pos- risks could be. Ev-/so the last time a wind/big wind storm came through was in the summertime. Luckily the Pinery wasn't, there wasn't a lot of threat to the Pinery, but, if there were a lot of people in the Pinery at that time of year, if there was a large wind storm…, anything like that, the more people, than the more- yeah- riskier" (P.H.S.2).

Seasonal population fluctuation data should be considered when monitoring and evaluating natural hazard risks, as this fluctuation challenges natural hazard risk management plans and specifically natural hazard risk management responses.

A local provincial government affiliated key informant identified an opportunity to use their camping registration system data to inform natural hazard risk monitoring and evaluation efforts:

"obviously we have to be cognizant of… privacy considerations and/and, those aspects. But there's a wealth of information there about things like party size, ratio of parents to child, average length of stay, peak occupation periods... So there's probably a treasure trove of information there about some human activity elements in parks that/that could be mined to look at, you know, when are the riskiest time periods, in terms of park occupation, number of individuals in the park that would, you know, exacerbate response plans" (P.G.L.1).

All available data should be more effectively used to inform natural hazard risk monitoring and evaluation efforts in the greater Pinery Provincial Park region.

Lastly, identifying natural hazard risk events that have occurred in other regions, and analyzing the responses of the organizations who were affected, was another need and opportunity identified in relation to the Risk Monitoring and Evaluation theme. For example, local provincial government and municipal local government affiliated key informants both indicated that they have experienced wind-related risk events:

> *"we are still assessing. So but ya I mean we probably lost another 3 feet of shoreline, you know that's 10miles of our shoreline, and that's just the park, so/so but, so what's happening is our day-use accesses are gone so we are going to have to shut those down, -a right now we are just getting around to our trails – we're trying to get to where the public go right now, and-a we will deal with that cause we want to manage any risk to the public and to ourselves obviously" (P.G.L.3)*, and, "*there was just one [wind warning] again two days ago. So the/the issue that we have with wind warnings, is it's- you know, Northwest and Northeast that presents a problem for us in a wind warning. So it's not every one warning, but the wind warnings currently, given the high lake levels in the Great Lakes- which isn't expected to recede anytime soon, in combination with, I would say any winds that are greater than 50 kilometers an hour, present issues to our entire shoreline… I can tell you that we've had inland flooding in Port Franks, which is just South of the Pinery Park, which we've never had in 30 years because of that change. And I can tell you that we've had inland flooding in Grand Bend, as a result of those winds on River Road and right up, right up through there. And we've had some beach erosion in Grand Bend, as a result of all that" (L.G.M.1)*; yet, there is minimal to absent communication of monitoring and evaluating efforts between these two organizations.

There is much to be learned from organizations who are experiencing similar natural hazard risk events.

Chapter 6: Discussion and Recommendations

6.1 Sendai Framework for Disaster Risk Reduction 2015-2030

The United Nations World Conference on Disaster Risk Reduction was a milestone event, hosted by the Government of Japan, to increase the profile of disaster risk reduction in development planning and practice. The Conference: "provides unique opportunities to promote strategic and systematic approaches at the national level to address vulnerabilities and to reduce risk to natural hazards" (United Nations Office for Disaster Risk Reduction, 2005). Outcomes that resulted from the Conference included: the *Yokohama Strategy and Plan of Action for a Safer World: Guidelines for Natural Disaster Prevention, Preparedness and Mitigation* (1994); the *Hyogo Framework for Action 2005-2015: Building the Resilience of Nations and Communities to Disasters*; and, most recently, the *Sendai Framework for Disaster Risk Reduction 2015-2030*.

The *Sendai Framework for Disaster Risk Reduction 2015-2030* was adopted at the third United Nations (UN) World Conference on Disaster Risk Reduction in Sendai, Japan, on March 18, 2015 (UNDRR, 2015). The goal of the *Sendai Framework* is to:

> prevent new and reduce existing disaster risk through the implementation of integrated and inclusive economic, structural, legal, social, health, cultural, educational, environmental, technological, political and institutional measures that prevent and reduce hazard exposure and vulnerability to disaster, increase preparedness for response and recovery, and thus strengthen resilience (UNDRR, 2015, p. 11),

and applies to:

> …the risk of small-scale and large-scale, frequent and infrequent, sudden and slow-onset disasters, caused by natural or manmade hazards as well as related environmental, technological and biological hazards and risks. It aims to guide the multi-hazard management of disaster risk in development at all levels as well as within and across all sectors. (UNDRR, 2015, p. 35)

The expected outcome that the *Sendai Framework* aims to achieve: "a substantial reduction of disaster risk and losses in lives, livelihoods and health and in the economic, physical, social, cultural and environmental assets of persons, businesses, communities and countries" (UNDRR, 2015, p. 11).

The *Sendai Framework* focuses on the role of State and non-State stakeholders in disaster risk management. The *Framework* identified various outcomes, goals, guiding principles, and priorities for action, that intend to build resilience to and reduce losses and damages caused by natural disasters. Specifically, the *Framework* identifies four priority areas for focused disaster risk management action:

> *Priority 1:* Understanding disaster risk;
> *Priority 2:* Strengthening disaster risk governance to manage disaster risk;
> *Priority 3:* Investing in disaster risk reduction for resilience; and
> *Priority 4:* Enhancing disaster preparedness for effective response and to "Build Back Better" in recovery, rehabilitation and reconstruction. (UNDRR, 2015, p. 35)

As explained previously in Chapter 4, specifically phase eight of Braun and Clarke's (2006) adapted *Six-Phase Thematic Analysis Approach*, the *Sendai Framework* was chosen to frame the discussion presented here. Key informants can help build resilience to and reduce losses and damages caused by natural hazards in the greater Pinery Provincial Park region if they are able to effectively integrate the *Sendai Framework's* four priorities. The *Framework's* four priorities are used here to discuss and provide recommendations with respect to natural hazard risk management efforts in the greater Pinery Provincial Park region. Specifically, the 12 main themes that arose from the interviews will be discussed in relation to the Sendai Framework's four priorities, as outlined in *Table 21*. By referencing the 12 main theme's specific definitions and the *Sendai Framework's* four priority's descriptions, the 12 main themes were sorted by relevance under the *Sendai Framework's* four priorities. While the discussion has been organized using the four priority areas of the Framework, it is important to recognize that many of the themes are interrelated and not mutually exclusive; enhancing (or even reduced) capacity in one priority area (and related themes arising from the research) will have effects on other priorities and themes.

Table 21 A discussion of the greater Pinery Provincial Park region case study's 12 main themes and the four priority areas of the Sendai Framework for Disaster Risk Reduction 2015-2030

	Priority 1	**Priority 2**	**Priority 3**	**Priority 4**

Sendai Framework	*Understand*	*Strengthen*	*Invest*	*Enhance*
12 Main Themes	Communication	Collaboration & Partnerships	Adaptive Management	*Recommendations*
	Knowledge Acquisition	Knowledge Integration & Decision-making	Planning	
	Knowledge Sharing & Exchange	Relationships	Plans, Policies, & Regulations	
	Risk Monitoring & Evaluation	Responsibility	Resources & Capacity	

6.1.1 Priority 1: Understanding Disaster Risk

Natural hazard risk management in the greater Pinery Provincial Park region needs to be based on an understanding of natural hazard risk in all its dimensions of vulnerability, capacity, exposure of persons and assets, hazard characteristics, and the environment (UNDRR, 2015). Priority 1 under the *Sendai Framework* states that: "disaster risk management needs to be based on an understanding of disaster risk in all its dimensions of vulnerability, capacity, exposure of persons and assets, hazard characteristics and the environment" (UNDRR, 2015, p. 35). When critically reflecting on the 12 main themes identified from the key informants' interviews, the themes of: 1) Communication, 2) Knowledge Acquisition, 3) Knowledge Sharing and Exchange, and 4) Risk Monitoring and Evaluation, best aligned with Priority 1 of the *Framework*. These themes are used below to help organize the discussion of Priority 1.

6.1.1.1 Communication

In order to understand and further manage natural hazard risks, more effective communication in the region will be required. Lin et al. (2017) states that while risk communication was once, "widely regarded as a one-way process focused on getting the appropriate message across, the field has advanced considerably since then, and it is now recognized to be a much more complex activity" (p. 1537). Fekete (2012) also explained that:

> there are two principal ways of risk communication: top-down or bottom–up. Governments and large organizations typically understand risk communication as a service that includes guidelines, information brochures and internet websites that are provided for the end-user - the people. This service is a rather passive way of communication…this is a rather traditional understanding of risk communication. Risk communication in this respect starts after everything else is completed. That is, after the risk analyses are ready and have been thoroughly tested, and after the relevant studies and research projects have ended successfully. This implies a time lag and does not typically allow for any outsider to learn about the risk management process until it has been finalized. (p. 73)

The greater Pinery Provincial Park region case study involved 15 key informants with a substantial role in natural hazard risk management. Echoed by the key informants that participated in the case study, Fekete (2012) emphasized that distributing information in a top-down manner alone is not effective for risk communication. Risk communication needs to flow in all directions throughout the entire risk management process. Similarly, Ivčević et al. (2019) emphasized that the communication gap between stakeholders (e.g., scientific community, decision-makers, managers, and the population) needs to be reduced.

An understanding of natural hazard risks and natural hazard risk management therefore requires communication between all stakeholders who have a main role in natural hazard risk management in the greater Pinery Provincial Park region. The need to reduce communication gaps between stakeholders in the greater Pinery Provincial Park region was emphasised by the key informants that participated in the study. This appears to be a common challenge identified in the literature. For example, Lin et al. (2017) noted that "research remains concentrated on the relation between experts and the public, while considerably less attention has been paid to communication between experts" (p. 1537).

Many similarities were identified when analyzing the findings and recommendations of both the greater Pinery Provincial Park region case study, that focused on natural hazard risks, and the findings of Ivčević et al. (2019) that: "critically reviewed the recent literature (from 2013 to 2017) using the Web of Science database of Clarivate Analytics to assess how indicators are currently being constructed in risk management, with a focus on risks of inundations, coastal and seismic risks" (p. 1). One specific recommendation that was identified both in the greater Pinery Provincial Park case study and by Ivčević et al. (2019) was the need for clearly defined risk-relevant terminology. Case study key informants

identified a need and opportunity to define the difference between a Risk Management Plan and an Emergency Management Plan, as it was evident in the interviews that the difference between these two plans was unclear (the names were used interchangeably). Ivčević et al. (2019) recommended: "the use of a defined terminology related to disaster risk reduction" (p. 2). Establishing an understanding of natural hazard risks and risk management should be a priority for the greater Pinery Provincial Park region.

Another key finding arising from the case study was the need more effective communication, especially with the public. The public is a key stakeholder that should not be excluded from natural hazard risk management communications within the greater Pinery Provincial Park region.

6.1.1.2 Knowledge Acquisition

Acquiring knowledge is crucial when attempting to understand disaster risks and natural hazard risks. The acquisition of new and existing knowledge can greatly inform disaster risk and natural hazard risk understanding. Paton et al. (2013) notes that:

> given the infrequent and complex nature of the hazard events they may have to confront, it is possible to anticipate that community members' deliberations could identify information and resource needs that cannot be met within existing community contexts. Under these circumstances, people would turn to civic and expert sources to acquire the necessary information and resources. (p. 22)

The need to acquire disaster and natural hazard risk-related knowledge will become ever more important in the face of climate change in the greater Pinery Provincial Park region. Knowledge will inform both proactive and reactive adaptation responses.

As Paton et al. (2013) notes, "individuals are reliant on expert and agency sources to help them acquire the information and advice required to inform their thinking and decision-making about preparedness" (p. 29). The strong need to strategically acquire knowledge from subject matter experts was evident in the case study findings. While knowledge can be acquired from subject matter experts to inform natural hazard and disaster risk management understandings, knowledge can also be acquired from internal staff that an organization employs. For example, while the Public Health sector affiliated key informants may often seek out external subject matter experts when acquiring natural hazard and

disaster risk knowledge, regional provincial government and local provincial government affiliated key informants, on the other hand, appear to be more comfortable and capable of acquiring their natural hazard risk and disaster risk knowledge internally from the subject matter experts that they employ. As Lemieux et al. (2018) notes, there "may be a level of comfort among a specific cohort of highly educated practitioners in managing the challenge of procuring and utilizing a diverse evidence base in decision-making" (p. 403).

6.1.1.3 Knowledge Sharing & Exchange

To establish an understanding of natural hazard and disaster risk, knowledge should be shared and exchanged. Fazey et al. (2012) define knowledge sharing and exchange as: "a process of generating, sharing, and/or using knowledge through various methods appropriate to the context, purpose, and participants involved" (p. 20). While knowledge acquisition is important when establishing an understanding of natural hazard and disaster risk, the: "accumulation of knowledge and information is not enough: the effectiveness of environmental management depends greatly on how knowledge is exchanged, with whom it is exchanged, and how it is used" (Fazey et al., 2012, p. 19).

Key informants from the greater Pinery Provincial Park region case study discussed various examples of internal and external knowledge sharing and exchange efforts. Generally speaking, sharing and exchanging natural hazard and disaster risk knowledge was perceived as important by key informants to support evidence-based decision-making. Effective natural hazard risk management requires strategic knowledge sharing and exchange, that informs evidence-based decision-making (Cvitanovic et al., 2016). However, what wasn't addressed by key informants were some of the many complexities associated with knowledge exchange. As Fazey (2012) states:

> it is usually easier, for example, to achieve exchange of knowledge when people are from similar backgrounds, such as researcher to researcher, compared to working with people who have very different goals, languages, pressures, needs and career paths, such as policy-makers and researchers… environmental management involves exchange of knowledge between people with different backgrounds and cultures, such as between practitioners and Indigenous people or between researchers and policy makers. However, consideration is rarely given to cultural and individual differences of participants involved in knowledge exchange. (pp. 26-7)

While key informants from the greater Pinery Provincial Park region case study reflected confidently on and provided numerous examples of internal knowledge sharing and exchange efforts, when asked about external knowledge sharing and exchange efforts, key informants were more likely to suggest ways knowledge sharing and exchange could be improved, as opposed to providing examples. Upon analysis of the key informant's interview transcripts, it was evident that all key informants were aware of the invaluable importance of knowledge sharing and exchange, an awareness that was shared with Cvitanovic et al. (2016). Cvitanovic et al. (2016) expressed that the: "growing awareness of the importance of knowledge exchange has also led to increased efforts by conservation scientists and decision-makers to implement strategies that support knowledge exchange and lead to evidence-based decision-making" (p. 865). Making science accessible to decision-makers, developing guidance for conservation scientists and practitioners, designing and implementing research programs, managing new knowledge following the completion of research programs, encouraging participatory and co-production research approaches, and involving intermediaries, such as knowledge brokers, were some of the strategies recommended by Cvitanovic et al. (2016) to improve knowledge sharing and exchange. In addition to these, key informants suggested that securing government support, requiring researchers to report back on research findings, adopting a story-telling approach when sharing and exchanging knowledge externally with the public, and sharing and exchanging knowledge in-person, as opposed to online, were strategies that could be used to improve knowledge sharing and exchange in the greater Pinery Provincial Park region.

Finally, it is worth noting that a key concern identified in the results is that many organizations fail to evaluate the effectiveness of knowledge sharing and exchange initiatives that they are involved in. Therefore, it is not known to what extent knowledge is being incorporated to improve decision-making. Knowledge acquisition is critical in understanding natural hazard and disaster risk; however, it is important that the knowledge acquired is assessed and evaluated with rigor. Only the best available information should inform understandings of natural hazard and disaster risk.

6.1.1.4 Risk Monitoring & Evaluation

The key informants that participated in the greater Pinery Provincial Park region case study, identified a need and opportunity to strengthen forecasting abilities to assist natural hazard risk management monitoring and evaluation efforts. Forecasting is the, "provision of timely information to improve the management in the emergency phase, that is, shortly before, during and after a hazardous

event" (Merz et al., 2020, p. 2), and is considered a cornerstone of risk reduction. As Merz et al. (2020) emphasizes:

> early warning systems are frequently used to predict the magnitude, location, and timing of potentially damaging events, these systems rarely provide impact estimates, such as the expected amount and distribution of physical damage, human consequences, disruption of services, or financial loss. Complementing early warning systems with impact forecasts has a twofold advantage: It would provide decision-makers with richer information to take informed decisions about emergency measures and focus the attention of different disciplines on a common target. This would allow capitalizing on synergies between different disciplines and boosting the development of multi-hazard early warning systems. (p. 1)

Key informants that participated in the greater Pinery Provincial Park region case study, in addition to other stakeholders, who have a main role in natural hazard risk management in the region, should therefore consider not only investing efforts in impact forecasting but also in early warning systems.

Zischg et al. (2013) argued that there are several factors influencing natural hazard risks, and climate change is only one of the factors, while Merz et al. (2020) further argued that the next challenge will be the interactions between hazards and vulnerabilities. The key informants that participated in the greater Pinery Provincial Park region case study, in addition to other stakeholders who have a main role in natural hazard risk management in the region, should begin to explore the other factors that may be influencing natural hazard risks in the region.

6.1.2 Priority 2: Strengthening Disaster Risk Governance to Manage Disaster Risk

The *Sendai Framework's* Priority 2 emphasizes that*:*

> disaster risk governance at the national, regional and global levels is vital to the management of disaster risk reduction in all sectors and ensuring the coherence of national and local frameworks of laws, regulations and public policies that, by defining roles and responsibilities, guide, encourage and incentivize the public and private sectors to take action and address disaster risk. (UNDRR, 2015, p. 35)

The themes: 1) Collaboration and Partnerships, 2) Knowledge Integration and Decision-making, 3) Relationships, and 4) Responsibility, identified after analysis of the key informant's interviews, were determined to best align with Priority 2 of the *Framework*. The greater Pinery Provincial Park region should prioritize natural hazard risk governance at the regional level as it is vital to the management of natural hazard risk reduction in all sectors and ensuring the coherence of regional frameworks of laws, regulations, and public policies that, by defining roles and responsibilities, guide, encourage and incentivize the public and private sectors to take action and address natural hazard risk (UNDRR, 2015).

6.1.2.1 Collaboration & Partnerships

Aided by genuine regional collaboration and partnership efforts, the greater Pinery Provincial Park region has the potential to strengthen natural hazard risk governance to manage natural hazard risk. Lin and Abrahamsson (2015) states that: "collaboration should not be limited to one dimension, but should include all sectors and all levels" (p. 175). While all of the key informants invited to participate in the case study had a main role in natural hazard risk management in the greater Pinery Provincial Park region, they represented distinctly different sectors and levels of governance (e.g., county, municipal, health care, NGO, etc.). The findings strongly suggest that that there is a need to focus efforts on strengthening collaboration and partnerships between the key organizations working in the region.

Regional provincial government and local provincial government affiliated key informants expressed confidence in their internal collaboration and partnership efforts. While regional provincial government and local provincial government affiliated key informants expressed confidence in their internal collaboration and partnership efforts, a need for improved collaboration with external actors was identified. The Public Health sector and local Indigenous communities, are all stakeholders with a main role in natural hazard risk management in the greater Pinery Provincial Park region; yet, they are not currently adequately included in collaboration and partnership efforts. Strategic efforts need to be made to ensure all those stakeholders, with a main role in natural hazard risk management in the greater Pinery Provincial Park region, are included in collaboration and partnership efforts and initiatives in order to strengthen natural hazard risk governance to manage natural hazard risk.

6.1.2.2 Knowledge Integration & Decision-making

Improved governance with respect to knowledge management was a key theme that emerged from the research. This is challenging, because as Eiser et al. (2012) notes:

> applying lessons from previous research on risk and decision-making to the context of natural hazards is especially challenging because of the increase in scale and complexity, and the fact that we need to consider the interactions between the decisions made by several actors rather than those of individuals considered singly. (p. 12)

Throughout the key informant's interviews, it became evident that natural science was the form of knowledge most frequently integrated into natural hazard risk management decisions. The employment of natural science knowledge, as opposed to social science, traditional ecological knowledge, Indigenous knowledge, and other forms of local knowledge, was dominant among key informants when making natural hazard risk management decisions. This is perhaps not surprising, given the findings of Lemieux et al. (2018) who noted that Indigenous knowledge is: "valued more than it is used in decisions pertaining to protected areas management, and the use of Indigenous knowledge is relatively low overall*"* (p. 401). There is a clear need to integrate traditional ecological knowledge, Indigenous knowledge, and other forms of local knowledge, more fully, into natural hazard risk management decision-making in the region.

The decision-making process can also strengthen natural hazard risk governance to manage natural hazard risk. Bier (2001) outlined various issues that are considered when making risk-related decisions. For example:

> legal requirements; possible adverse effects of the particular hazard being regulated; available options for reducing the risk; extent of concern about the issue on the part of various groups; and reliability of the information on which the decision will be based, (p. 152),

are some of the issues considered when making risk-related decisions.

Pollard et al. (2008) similarly explained that when making environmental decisions, decision-makers are mostly focused on balancing risk and reward or loss versus gain. When making risk-informed decisions, decision-makers: understand the significance of a risk, decide whether it requires management, determine the cost to manage the risk, and implement the decision effectively (Pollard et al., 2008). Pollard et al. (2008) go on to note that: "a transparent network, face to face interaction, and a shared context of understanding are all thought to aid improved decision-making" (p. 28).

6.1.2.3 Relationships

The establishment and maintenance of relationships plays a critical role in satisfying the *Framework's* Priority 2, which focuses on strengthening disaster risk governance to manage disaster risk. It was evident throughout the key informant's interviews that the existence of relationships facilitated knowledge mobilization in the region. One of the most important factors to consider when establishing and maintaining a relationship is trust (Curnin et al., 2015). As Paton (2007) explains:

> trust influences perception of other's motives, their competence and the credibility of the information they provide. As such, it would be expected to play a prominent role in mediating relationships concerned with acquiring information about, understanding, and taking action to mitigate infrequently-occurring natural hazard consequences. (p. 371)

All 15 key informant participants discussed the importance of trust when establishing and maintaining relationships, in the greater Pinery Provincial Park region. Relationships are critically important when attempting to strengthen natural hazard risk governance to manage natural hazard risk; however, even more important is to ensure that these relationships are reinforced by unwavering trust.

6.1.2.4 Responsibility

Responsibility was also a theme identified after thorough analysis of the key informant's interviews; however, responsibility is also an important aspect to consider when attempting to strengthen natural hazard risk governance to manage natural hazard risk. Raikes and McBean (2016) explained that:

> as it stands in Canada, municipalities are principally responsible for emergency management within their communities. With predictions of more frequent and intense severe weather events in the future, a community's ability to withstand the impacts and recover from impacts from an event will be significantly challenged. (p. 17)

Responsibility was viewed and discussed by the key informants as internal responsibility (their organization's responsibility) or external responsibility (not their organization's responsibility). Yong et al. (2017) states that the: "Canadian public believed that the government and community were responsible for disaster management" (p. 2329). With the exception of the Public Health sector affiliated key informants, all other key informants felt that their organization was responsible for managing natural hazard risks; however, it was emphasized that risk cannot be eliminated, and the public should take the

initiative to inform themselves of the known risks that may be encountered when visiting the region. The greater Pinery Provincial Park region case study key informants remarked that the public inadequately takes the necessary initiatives to inform themselves of the known risks that may be encountered when visiting the region. Paton et al. (2013) suggests that this may be because: "decisions to prepare are more likely, if they (the public) believe that their relationship with formal agencies is fair and empowering (e.g., agencies are perceived as trustworthy, as acting in the interest of community members)" (p. 22). According to Paton et al. (2013) statement, stakeholders with a main role in natural hazard risk management need to focus on developing their relationships with the public, in order for the public to feel confident in taking responsibility for natural hazard risk preparedness when visiting the region. Yong et al. (2017) elaborated on their unique view of the public's perception of risk and risk preparedness:

> individuals' risk perception is a cogent, rich structure that is beyond the evaluation of hazard characteristics. Individuals' risk perception is value-laden as it consists of beliefs about responsibility, control, acceptability, and response regarding the hazards. Accordingly, we defined individuals' risk perception for natural disasters as a multidimensional structure consisting of beliefs about natural disaster risks and issues. (p. 2322)

If the greater Pinery Provincial Park region wishes to strengthen natural hazard risk governance to manage natural hazard risk, Yong et al. (2017) suggests that a mutual responsibility for natural hazard preparedness should exist between the public and stakeholders with a main role in natural hazard risk management.

6.1.3 Priority 3: Investing in Disaster Risk Reduction for Resilience

Priority 3 of the *Sendai Framework* states that:

> public and private investment in disaster risk prevention and reduction through structural and non-structural measures is essential to enhance the economic, social, health and cultural resilience of persons, communities, countries and their assets, as well as the environment. These can be drivers of innovation, growth and job creation. Such measures are cost-effective and instrumental to save lives, prevent and reduce losses and ensure effective recovery and rehabilitation. (UNDRR, 2015, p. 35)

Given the above, the greater Pinery Provincial Park region should explore opportunities for public and private investment in natural hazard risk prevention and reduction. The four themes, identified after analysis of the key informant's interviews, related to investing in disaster risk reduction for resilience include: 1) Adaptive Management, 2) Planning, 3) Plans, Policies and Regulations, and 4) Resources and Capacity.

6.1.3.1 Adaptive Management

In order to invest in natural hazard risk reduction for resilience, stakeholders with a main role in natural hazard risk management in the greater Pinery Provincial Park region should commit to more effective implementation of adaptive management. Adaptive management will help both better react to natural hazard events and anticipate future impacts through proactive adaption where appropriate (Ismail-Zadeh et al., 2017; Thaler et al., 2019). Adaptation in this regard should involve a series of incremental adaptation strategies that work to build capacity over the long term. Regional provincial government and local provincial government affiliated key informants expressed that while their organizations should focus more on proactive natural hazard risk management planning, implementation of proactive measures is often difficult. As Kunreuther (2020) explains:

> a principal reason why we do not undertake proactive measures to reduce future losses is that we often prefer to not change our current behavior. This tendency to maintain the status quo saves us time and energy by not having to collect information on the costs and benefits of new alternatives. This behavior is defended in proverbs and aphorisms ('better the devil you know than the devil you don't' and 'when in doubt, do nothing'). (pp. 2267-8)

Being proactive should involve exploring opportunities for public investment in natural hazard risk prevention and reduction. As Paterson et al. (2012) states, the success of adaptation efforts "rely on local political will and federal support, multidisciplinary partnerships and local leaders" (p. 6), and should include "public health agency participation in the development of adaptation plans" (p. 6). While the regional local government and the municipal local government play a critical role in natural hazard adaptive management, collaboration between health and natural resource management agencies in the region has been challenged overall. As identified previously, Public Health sector affiliated key informants stated that they are inadequately included in natural hazard risk management in the region. Stakeholders with a main role in natural hazard risk management should work to more effectively facilitate the Public Health sector's involvement in natural hazard risk management. The Public Health

sector should likewise be more effectively engaged to contribute to natural hazard risk management in the region, as they will be increasingly called upon to assist not only with medical care, but also with overall coordinated regional responses to future natural hazard risk management issues.

Overall, Rivera et al. (2015) identified that the "need for better integration of climate change adaptation considerations and disaster risk management has been widely recognised. However, practical examples are still very limited" (p. 445). Investing in natural hazard risk planning is an effective way to reduce the impact of natural hazard risks and build resilience to natural hazard risks. Failing to proactively plan for natural hazard risks can result in negative outcomes.

6.1.3.2 Planning

There is also a need for more effective management planning in the greater Pinery Provincial Park region to build resilience to natural hazard risks. As Pearce (2002) notes, there is "a relationship between the degree to which communities accept disaster management planning and the degree to which they experience disasters: the greater the exposure to disasters, the greater the interest in disaster management" (p. 212). When planning for natural hazard risks, such as wind-events and tornadoes, stakeholders in the greater Pinery Provincial Park region should consider the unique characteristics of the local population. Pearce (2002) stressed that if the unique characteristics of the local community are ignored, there is a decreased chance that reasonable solutions to natural hazard risk-related problems will be effective and promote regional resilience. Stakeholders with a main role in natural hazard risk management in the region should consider the unique demographics that make up their population (e.g., young visitors and senior residents) when planning for and managing natural hazard risks. Relatedly, this should go beyond 'one-way' communication of information. As Pearce (2002) notes: "posting notices for opportunities to participate is important, but unless emergency planners make active efforts to directly involve community residents in the planning process, these opportunities may be ignored" (p. 219). It is critical that the greater Pinery Provincial Park region's population be more effectively engaged in the natural hazard risk management planning process.

6.1.3.3 Plans, Policies and Regulations

Key informants who participated in the case study were able to identify ample examples of plans, policies, and regulations that were relevant to natural hazard risk management in the region. However, such plans may be challenged by climate change, which may create a "policy window" upon which large-scale adaptation efforts can be triggered (Thaler et al., 2019). As Levy and Gopalakrishnan (2010) note:

> devastation and loss allows for new opportunities to manage disaster risk in ways characterized by adaptation, transformation and resilience: traditional plans and policies for mitigating disaster losses are inadequate and so decision-makers must understand how natural hazards impact their communities and the policy frameworks in which they are managed. (p. 318)

If embraced proactively by decision-makers, particularly the provincial government, the greater Pinery Provincial Park region's plans, policies, and regulations, relevant to natural hazard risk management, have the potential to benefit from climate change.

The *Hyogo Framework for Action* and the *Sendai Framework for Disaster Risk Reduction* encouraged governments and organizations: "to integrate disaster risk reduction considerations into their sustainable development policy, planning and programming at all levels" (Gall et al., 2015, p. 255). Creating plans, policies and regulations that are more robust and capable of coping with rapidly changing environments, in addition to building a culture of natural hazard risk resilience (e.g., establishing grass-roots disaster education programs and increasing public awareness about natural hazard risks), are two examples of investments that can be made to reduce natural hazards for resilience in the greater Pinery Provincial Park region (Levy & Gopalakrishnan, 2010).

6.1.3.4 Resources and Capacity

Priority 3 of the Framework outlines the need to invest in disaster risk reduction for resilience, a priority that directly aligns with the Resources and Capacity theme. However, Pollard et al. (2008) stressed that most organizations manage risk in a climate of constrained resources. Money, time, staff, and training are all types of resources identified by the greater Pinery Provincial Park region case study's key informants in need of greater investment to ensure more effective natural hazard risk reduction. Without the necessary human and financial resources, managing natural hazard risks proactively and reactively will remain a challenge. Leveraging resources will be key and it will be important to establish relationships with other organizations in the region to mutually share resources. However, as Scott & Few (2016) note, resources are often more constrained at local (regional) scales, and there will always be a need for more resources.

Investments in establishing and strengthening capacity was also an identified need by the key informants. Gaillard et al. (2019) states that: "capacities refer to the set of diverse knowledge, skills and resources people can claim, access and resort to in dealing with hazards and disasters" (p. 863). Upon analysis of the interviews, it was found that natural science was the main form of knowledge being accessed by the key informants when managing natural hazard risks. Alternatively, social science knowledge, traditional ecological knowledge, Indigenous knowledge and other forms of local knowledge were not being adequately accessed and used when managing natural hazard risks. Investments should be made specifically focused on improving stakeholder capacity to understand, access, mobilize, and use social science knowledge, traditional ecological knowledge, Indigenous knowledge and other forms of local knowledge, as the more knowledge stakeholders have, the more capacities they can resort to. The greater Pinery Provincial Park region's stakeholders can work effectively towards Priority 3 of the *Framework* by prioritizing capacity development. This can be done by strengthening the competencies and skills of an organization, group, or community to sustainably drive disaster risk reduction efforts and development in the future (Scott & Few, 2016).

Overall, a greater investment of resources (e.g., money, time, staff, and training), broadening the forms of knowledge used to inform decisions (e.g., social science knowledge, traditional ecological knowledge, Indigenous knowledge and other forms of local knowledge), and establishing and maintaining relationships, are examples of the ways that stakeholders can work to build natural hazard risk management capacity in the greater Pinery Provincial Park region.

6.1.4 Priority 4: Enhancing Disaster Preparedness for Effective Response, and to "Build Back Better" in Recovery, Rehabilitation and Reconstruction

Lastly, the fourth *Sendai Framework* priority focuses on "building back better" (UNDRR 2015). As Priority 4 of the *Framework* states:

> experience indicates that disaster preparedness needs to be strengthened for more effective response and ensure capacities are in place for effective recovery. Disasters have also demonstrated that the recovery, rehabilitation and reconstruction phase, which needs to be prepared ahead of the disaster, is an opportunity to 'Build Back Better' through integrating disaster risk reduction measures. Women and persons with disabilities should publicly lead and promote gender-equitable and universally accessible approaches during the response and reconstruction phase. (UNDRR, 2015, p.35)

Numerous recommendations are outlined in *Table 22* that can be used by stakeholders working in the greater Pinery Provincial Park region to support initiatives that support the "build back better" priority. These recommendations according to the 12 main themes identified, and further into immediate term and short term recommendations.

Table 22 Summary of recommendations to enhance collaboration and knowledge sharing related to wind-related natural hazard risk management in the greater Pinery Provincial Park region.

Theme 1: Adaptive Management	**Recommendations**	
	Immediate Term	***Short Term***
	• Work to better understand natural hazard risks in the region, especially as related to future climate change • Begin the process of proactively understanding and planning for natural hazard risks in the region	• Create and acquire more social and spatial data to support natural hazard risk assessment/projections • Use experience and evidence to improve natural hazard risk management in the region incrementally and continuously over time
Theme 2: Collaboration & Partnerships	**Recommendations**	
	Immediate Term	***Short Term***
	• Invest greater financial and human resources to support collaboration and partnership efforts in the region, including with the Public Health sector and Indigenous people/communities • Establish a regional natural hazard risk management committee, fully representative of stakeholders in the region	• Explore the potential benefits of engaging volunteers and volunteer groups in natural hazard risk management (e.g., Lambton Shores Nature Trails, Lambton Wildlife, volunteer firefighters, etc.)
Theme 3: Communication	**Recommendations**	
	Immediate Term	***Short Term***
	• Explore ways in which diverse stakeholder groups	• Consider ways to effectively use social media when externally

	can work together to develop communication strategies related to natural hazard risk management in the region • Examine ways in which Indigenous knowledge can be more effectively incorporated into communication strategies and mediums (e.g., in-park, web, etc.)	communicating natural hazard risk management information, especially to park visitors
Theme 4: Knowledge Acquisition	**Recommendations**	
	Immediate Term	***Short Term***
	• Invest in research and knowledge mobilization to better understand barriers to use of different forms of knowledge in the region and identify opportunities for more effective integration (especially social science knowledge, traditional ecological knowledge, Indigenous knowledge, and other forms of local knowledge)	• Obtain greater Pinery Provincial Park region site-specific knowledge
Theme 5: Knowledge Integration & Decision-making	**Recommendations**	
	Immediate Term	***Short Term***
	• N/A	• Integrate social science knowledge more effectively into natural hazard risk management decision-making • Integrate traditional ecological knowledge, Indigenous knowledge and other forms of local knowledge more effectively into natural hazard risk management decision-making
Theme 6:	**Recommendations**	
	Immediate Term	***Short Term***

Knowledge Sharing & Exchange	• Require researchers to report back on research findings, in a formal or informal manner, to support risk management activities in the region • Adopt a story-telling approach when sharing and exchanging knowledge externally with the public • Evaluate the effectiveness of knowledge sharing and exchange initiatives	• Prioritize the sharing and exchanging knowledge both in-person, and online • Secure government-support to share and exchange social science knowledge and traditional ecological knowledge, Indigenous knowledge and other forms of local knowledge
Theme 7: Planning	**Recommendations**	
	Immediate Term	***Short Term***
	• Establish clear goals when planning and managing for natural hazard risks • Focus efforts on proactive natural hazard risk management planning in anticipation climate change effects • Involve, more effectively, Public Health sector affiliated key informants in natural hazard risk management planning	• Plan with the greater Pinery Provincial Park region's unique demographic composition in mind (e.g., young visitors and senior residents)
Theme 8: Plans, Policies & Regulations	**Recommendations**	
	Immediate Term	***Short Term***
	• Confirm that all organizations have a risk management plan and reflect up-to-date information • Define the difference between a Risk Management Plan and an Emergency Management	• Begin strategic planning to address other natural hazard risks that are expected to increase in occurrence and severity as a result of climate change

	Plan and communicate such differences to stakeholders • Share Pinery Provincial Park Risk Management Plan with stakeholders in the region • Include Public Health sector affiliated key informants in the development of regional risk management plans and related planning initiatives	
Theme 9: Relationships	**Recommendations**	
	Immediate Term	***Short Term***
	• Commit to genuinely establishing long-term relationships with local Indigenous communities	• Establish relationships within the region that better represent all stakeholders involved in risk management • Stress openness and transparency when attempting to establish and maintain relationships in the greater Pinery Provincial Park region
Theme 10: Resources & Capacity	**Recommendations**	
	Immediate Term	***Short Term***
	• Invest in more and continued staff training related to natural hazards and natural hazard risk management	• Increase availability and access to financial resources to support risk management activities • Invest in staff training related to natural hazard risk management, including student summer employment • Acquire resources to support more effective acquisition and sharing of social science knowledge, traditional ecological knowledge, Indigenous knowledge, and other forms of local knowledge

		through, for example, knowledge sharing forums
Theme 11: Responsibility	**Recommendations**	
	Immediate Term	***Short Term***
	• Pinery Provincial Park should proactively communicate risks and risk management approaches to stakeholders and the public in the region	• Advocate that the public take responsibility to educate themselves on the known risks prior to visiting the greater Pinery Provincial Park region (e.g., become familiar with Ontario Park's website/blog, Pinery app, and social media accounts)
Theme 12: Risk Monitoring & Evaluation	**Recommendations**	
	Immediate Term	***Short Term***
	• Consider population fluctuation when monitoring and evaluating natural hazard risks in the region • Identify natural hazard risk events that have occurred in other regions and analyze the responses of the organizations who have been affected to support effective, timely responses	• Acquire more data related to natural hazard risks in the region • Strengthen forecasting abilities to assist natural hazard risk management monitoring and evaluation efforts

Chapter 7: Conclusion

Utilizing an adapted version of Braun and Clarke's (2006) inductive, thematic approach, 12 main themes were identified in the research. These themes included: 1) Adaptive Management; 2) Collaboration and Partnerships; 3) Communication; 4) Knowledge Acquisition; 5) Knowledge Integration and Decision-making; 6) Knowledge Sharing and Exchange; 7) Planning; 8) Plans, Policies, and Regulations; 9) Relationships; 10) Resources and Capacity; 11) Responsibility; and, 12) Risk Monitoring and Evaluation. Each of the 12 themes were further coded into strengths, weaknesses, and needs and opportunities. Strengths (e.g. transparent internal communication and integration of natural science knowledge into decision-making), weaknesses (e.g. lack of collaboration and partnerships with Indigenous communities and an absent understanding of social science and its' value), and needs and opportunities (e.g. Public Health sector stakeholders in natural hazard risk management and more dedicated resources to support capacity), specific to the 12 main themes, were identified after deeper examination of the data. Following this, the *Sendai Framework for Disaster Risk Reduction 2015-2030* was used to deductively analyze the data and develop recommendations to enhance capacity to respond to natural hazard events in the greater Pinery Provincial Park region. Recommendations included, but were not limited to: 1) focusing efforts on proactive natural hazard risk management planning in anticipation climate change effects; 2) integrating social science knowledge, traditional ecological knowledge, Indigenous knowledge and other forms of local knowledge more effectively into natural hazard risk management decision-making; 3) involving, more effectively, Public Health sector personnel in natural hazard risk management planning; and, 4) increasing availability and access to financial resources to support risk management activities. Effective implementation of such recommendations would help enhance the capacity of stakeholders to more effectively plan and manage for natural hazard events in the region.

This thesis has revealed various findings related to how knowledge of natural hazard risk management is (or is not) used, produced, shared, and managed within the greater Pinery Provincial Park region, and represent an important contribution to what is known about how knowledge of natural hazard risk management is (or is not) used, produced, shared, and managed within Ontario's parks and protected areas. This has important implications for the parks and protected area's research community as this research study will advance a critical and understudied research gap related to natural hazard risk management in protected areas organizations, by using a multi-stakeholder and case study approach, and for the natural hazard risk management-stakeholders in the greater Pinery Provincial Park region, as this research study will provide a foundation for long-term collaboration in support of adaptive management.

The important findings noted above, while making an important contribution to the scholarly and practical literature pertaining to parks and protected areas and risk management, should be considered considering a number of methodological limitations. First, few research studies have attempted to consider the complex issue of parks and protected areas visitor management, natural hazards, climate change, risk management, and knowledge use, production, sharing, and management, at once. The thesis integrated a wide body of complex literature. This made comparisons between existing research and similar case studies difficult. Second, and relatedly, while a case study approach allows for an exploratory, explanatory, and descriptive research study, limitations to a case study approach include generalizability and limited transferability of findings from single cases to other situations (Baxter & Jack, 2008; Carruthers Den Hoed et al., 2020; Cvitanovic et al., 2017; Yin, 2003). The findings from this case study may be difficult to apply to other locations and planning and management contexts.

Third, there are specific limitations characteristic of qualitative analysis. Qualitative analysis draws broad conclusions from instances or makes inferences about the unobserved based on the observed; furthermore, the generality of qualitative analysis is deemed a limitation (Polit & Beck, 2010). This limitation may affect natural hazard risk management stakeholder's abilities to implement specific recommendations. Expanding on this point, Polit & Beck (2010) stated that: "many leaders in qualitative research have begun to note the importance of addressing generalization, to ensure that insights from qualitative inquiry are recognized as important sources of evidence for practice" (p. 1451). Fourth, research bias is another potential limitation associated with qualitative analysis (Young et al., 2018). In this research thesis, however, a four-person research team analysed the interviews. Involving multiple people in the analysis of the key informant's interviews worked to limit any potential biases.

Fifth, while interviews fill a gap in knowledge that other methods are unable to bridge efficaciously, investigate complex motivations and behaviours, and collect a diversity of meaning, opinion, and experiences, interviews also possess various limitations (Hay, 2016). Alsaawi indicated that interviews are: "time consuming, as the researcher needs to go through a long process, starting from establishing access to making contact with participants, conducting the interview followed by transcribing the data and making use of it" (Alsaawi, 2014, p. 154). Other potential limitations to in-person (face-to-face) interviews include: "1) bias in terms of sampling, 2) interviewer and interviewee bias, 3) too much data, making analysis difficult, 4) challenges in recruiting interviewees when discussion contentious or sensitive topics, and 5) time, energy, sensitivity and caution establishing an ethical

relationship between researcher and participant" (Young et al., 2018, p. 17). Again, it is important to note that these limitations are not unique to this research study, rather these limitations are common of the interview method.

Sixth, as stated above, the key informant research response rate was 65%; however, the organization research response rate was 100%. In some cases, multiple key informants were invited to participate from an organization; yet, only one key informant accepted the invitation or an organization only offered to have one of their employees participate in the research study; moreover, this limited the number and diversity of responses. Relatedly, Indigenous individuals and communities were not interviewed a part of the research study. Because Indigenous individuals and communities were not interviewed a part of the research study, traditional ecological knowledge, Indigenous Knowledge and other forms of local knowledge mobilization, cannot be not fully understood from the interviews conducted for this study. However, key informant participants who work closely with the local Indigenous individuals and communities within the greater Pinery Provincial Park region did reflect on some of the challenges and opportunities relating to Indigenous knowledge and other forms of local knowledge mobilization.

In future, it is important to ensure that Indigenous individuals and communities are specifically included in climate change research studies as Indigenous individuals and communities are vulnerable to both the impacts and potential solutions to climate change (Townsend et al., 2020). Involving Indigenous individuals and communities in climate change research studies can help "mitigate the risk of maladaptation, avoid entrenchment of inequitable power dynamics, and ensure that even the most marginal groups within Indigenous communities benefit from adaptation policies and programmes" (Johnson et al., 2021, p. 1). Lastly, involving local Indigenous communities from the greater Pinery Provincial Park region in future research endeavors would affirm respect for community customs and codes of research practice to better ensure balance in the relationship between researchers and participants, and mutual benefit in researcher-community relations. Wilfrid Laurier University frequently conducts research in the greater Pinery Provincial Park region; moreover, it would be valuable to dedicate genuine efforts towards forming relationships with the local Indigenous communities.

Seventh, key informants were probed with a general description of social science. Despite being probed with this description of social science, it became evident through key informant responses that there was a limited understanding of what social science is. Consequently, some participants struggled

providing recommendations on how it could be strategically applied and incorporated to enhance natural hazard risk management in the greater Pinery Provincial Park region. Bennett et al. (2016) has similarly noted that social sciences remain misunderstood and underutilized in practice. While epistemology, training, experience, capacity, and different interests, may be reasons for why social sciences are not well understood and applied, genuine efforts to understand and apply social sciences should be prioritized as they can provide unique and important contributions to society's understanding of the relationships between humans and nature, and they can improve natural hazard risk management practices and outcomes in Ontario's parks and protected areas (Bennett & Roth, 2015; Bennett et al., 2016). While limitations to the research study were identified, such limitations only yield opportunities for future research.

In the last decade and especially since the onset of the COVID-19 pandemic, visitation to Canada's and Ontario's parks and protected areas has increased dramatically (Canadian Parks and Wilderness Society, 2020). While visitation and tourism has increased, it is also anticipated that natural hazard risks will increase in occurrence and severity because of climate change. Consequently, current approaches to natural hazard risk planning and visitor management initiatives will be challenged in the future. As this thesis has revealed, risk management is a shared responsibility, and all stakeholders with a role in natural hazard risk management should prioritize the use, production, sharing and management of knowledge pertaining to natural hazards including lessons learned.

Guided by the *Sendai Framework for Disaster Risk Reduction 2015-2030*, the findings of this research study suggest that there is a need and opportunity to fully understand: communication, knowledge acquisition, knowledge sharing and exchange, and risk monitoring and evaluation, related to natural hazard risk management in the greater Pinery Provincial Park region. Furthermore, this research study reveals a need and opportunity to strengthen collaboration and partnerships, knowledge integration and decision-making, relationships, and responsibility amongst stakeholders with a role in natural hazard risk management. Lastly, there will be an urgent need to invest in natural hazard risk management through adaptive management, planning, plans, policies and regulations and resources and capacity. In addition to the four other case studies that are part of the SSHRC-funded Canadian Parks Research Network initiative's efforts, there is still a need for further research to draw comparisons and confirm these findings more broadly.

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Appendix A: In-Person Interview Questions

PART 1: Establishing the Risk Management Context

1. What types of risks are most prevalent in the Pinery Provincial Park region?

   Probe: E.g., technology risk, health risk, crime risk, natural hazard risk, etc.

   a. Do the types of risks, most prevalent in the Pinery Provincial Park region, vary depending on the season (e.g., winter, spring, summer or fall)?

2. In your opinion, how vulnerable is the Pinery Provincial Park region to natural hazard risks, specifically wind/tornado hazards?

   Probe: Vulnerability = the conditions determined by physical, social, economic, and environmental factors or processes, which increase the susceptibility of a community to the impact of hazards.

   a. Does your organization attempt to manage its vulnerability to natural hazard risks? If so, please provide an illustrative example of such management practice.
   b. Could your organization's attempts to manage its vulnerability to natural hazard risks, potentially exacerbate natural hazard wind/tornado risk? If so, please explain.

3. How would you describe the coordination of risk management in the region?

   Probe: I.e., how are responsibilities shared? within and across sectors and with relevant stakeholders at all levels.

4. How would you describe public involvement in risk management in the region?

   a. Is your organization's risk management plan accessible by the public?
   b. Did the public have the opportunity to participate in the development of risk management plans?

5. When was the last natural hazard occurrence in the park (or park region)? What type of natural hazard was it?

   a. What was the outcome? Please provide exact or approximate date.

PART 2: Knowledge Management

1. *Can you describe (1-to-3) important decisions that you made in relation to risk management at/(in the) Pinery Provincial Park (region)?

   a. *For each decision, would you please describe how the decision was made?
   b. *Now would you outline what kinds of information were used to assist in making each decision.

Probe: Types of information (e.g., colleagues, government documents, e.g., do you use risk maps, baseline data, peer-reviewed articles, government reports, weather data, etc.)

2. *How has knowledge and what kind of knowledge, has typically been integrated in planning and management at/(in the) Pinery Provincial Park (region)?

   Probe: Some time period may be useful (e.g., over the past 2 to 5 years)?

3. *What trends do you see in accessing and using various types of knowledge in management and planning decisions at/(in the) Pinery Provincial Park (region)?

4. *Can you describe a decision where **social science** (e.g., psychology, sociology, political science) was used to help with the decision-making relative to risk management?

   Probe: Social Science= any discipline or branch of science that deals with human behaviour in its social and cultural aspects; how individuals interact with each other: in small groups, families, and communities, as well as within populations and in society; examples of disciplines: anthropology, sociology, social psychology, political science and economics

   a. *Why was social science integrated into risk management efforts?
   b. *Can you describe any difficulties or barriers in accessing or applying appropriate social science information in making decisions such as this, at/(in the) Pinery Provincial Park (region)?

   Probe: Relate this back to theoretical context, and known barriers/enabling factors.

5. *Can you describe a decision where **natural science** was used to help with decision-making? Why was natural science integrated into management of this particular issue? Was it easier to incorporate natural science, relative to social science in this example situation?

   Probe: Natural Science= a science involved in studying phenomena or laws of the physical world; a branch of science concerned with the description, prediction, and understanding of natural phenomena, based on empirical evidence from observation and experimentation; is understood to be everything with inanimate and animals nature (i.e. biology, physics, chemistry, geology, geography, astronomy, and Earth sciences)

   a. *What were the enabling conditions that helped access natural science information useful for decision-making?
   b. *Can you describe any difficulties or barriers in accessing appropriate natural science information in making decisions?

   Probe: Relate this back to theoretical context, and known barriers/enabling factors.

6. *Can you describe a situation where **traditional ecological knowledge, Indigenous knowledge or other forms of local knowledge** were used to help with making a decision?

   Probe: Indigenous Knowledge/ Local Knowledge/ TEK= refers to the understandings, skills and philosophies developed by societies with long histories of interaction with their natural surroundings; informs decision-making about fundamental aspects of day-to-day life; integral to a cultural complex that also encompasses language, systems of classification, resource use

practices, social interactions, ritual and spirituality; provide a foundation for locally-appropriate sustainable development.

a. *What were the enabling conditions that helped access traditional ecological knowledge, Indigenous knowledge or other forms of local knowledge useful for decision-making?
b. *Can you describe any difficulties or barriers in accessing appropriate traditional ecological knowledge, Indigenous knowledge or other forms of local knowledge in making decisions?

Probe: Relate this back to theoretical context, and known barriers/enabling factors.

7. *Do you think some forms of knowledge can be integrated into risk management easier than others? Why do you think that?

8. *Many researchers suggest that management decisions have traditionally used primarily natural sciences to help them plan and manage protected areas.

    a. *Would you agree with this assessment, and why or why not?
    b. *What would it take for either social science, traditional ecological knowledge, Indigenous knowledge or other forms of local knowledge, to be more fully integrated into parks planning and management?

9. Has your organization's risk management plan, or the risk management plan that you follow, been updated/revised to reflect the most up-to-date knowledge, information, and data?

    a. How current is it?
    b. Specifically, does your organization's risk management plan take into consideration the impacts of climate change?

10. How are individuals, a part of your organization, informed about your organization's risk management plan(s)/risk management plans that influence your organization?

    a. When organizational staffing changes occur, are your organization's risk management plans reviewed with new personnel? Or, are individuals expected to take the initiative themselves, and review the plan? Do individuals have to "sign off" stating that they were sufficiently educated on the organization's risk management plan?

PART 3: Knowledge Sharing & Exchange

1. How does your organization disseminate knowledge to partners in the region's collaborative efforts to mitigate natural hazard risks?

    a. Who is your organization's knowledge shared with (i.e., only internally within the organization, in collaboration with other local organizations, provincially, federally, across sectors, etc.)?

2. How could other organizations/partners benefit from <u>your knowledge</u> of natural hazard risk management?

a. Which organizations/partners do you feel your organization's natural hazards risk management knowledge would benefit from, if greater collaboration was established?

3. *What, if any, barriers do you experience in efficient and effective knowledge sharing (or exchange) efforts?

    a. *How did you/can you overcome these barriers?

4. What is your greatest knowledge need when it comes to nature-hazard risk management?

    Probe: What social science, natural science, TEK/Indigenous knowledge/ or other forms of local knowledge, should be prioritized to inform your agency's risk management efforts?

5. Do you share experiential knowledge following a natural hazard event, in order to "Build Back Better" (strengthen future risk management)?
(*Follow-up*)
    a. **If yes**, how?
    b. **If no,** is there a need to do so? If yes, how should you and partners go about doing this?

PART 4: Risk Management and Visitors to Pinery Provincial Park

1. What knowledge do you use to proactively increase public education and awareness of natural hazard risk?

    a. How do you share this knowledge? (i.e., word-of-mouth, text messages, social media postings, p.a. announcements)?

    Probe: This can focus on prevention and/or response.

2. Do you believe your organization is regarded as a trustworthy organization by the public?
(*Follow-up*)
    a. **If so,** please provide an illustrative example.
    b. **If not,** please explain why your organization may not be regarded as a trustworthy organization by the public.

    c. Can you suggest ways to build trust between our organization and the public?

(Park Staff Only)

3. Do you collect social science data from visitors to the park, that would be helpful in mitigating natural hazard risk and promote visitor (and resident) safety?

    Probe: Attitudes, knowledge, and behaviour in the park that could be useful to risk management?

PART 5: "Build Back Better"

1. How can risk management strategies be designed in the future to improve knowledge exchange in support of collective, evidence-based decision-making pertaining to natural hazards?

    a. What would successful knowledge exchange look like in relation to your work?

Probe: e.g., sharing experiences, lessons learned, best/good practices, training, and education could be used to build knowledge on natural hazard risk management in the region.

2. At the completion of this project we would like to produce guidance that can help others to learn from your experiences. How can the risk management community of practitioners, including academia and scientific research institutions, work more closely together to create knowledge in support of risk management?

Appendix B: Quotation Summary Tables

Theme 1: Adaptive Management
Strengths • *"we are such a large organization and operate across the province, we're in a cycle of continuous learning and improvement. So, areas where there might be an exacerbation of risk, would be a learning opportunity. And in that way, I think it really helps us to mitigate it in the future… always new events we recognize, and part of the training is that we don't rest on knowing that we've through something, so we know how to handle it. We just use that as a tool and then are expecting each part to have its, unique elements of it" (P.G.R.1)* • " *, we take measures of managing our liability to minimize the hazards within the park. Known hazards are to be/to be managed if they present, situations of injury or damage to property to the park users or to staff. So we/we're long established. We've been in this business for about 125 years, have approximately 200 parks. As an organization, we have experienced a lot of potential risks and hazards and have taken a lot of measures to mitigate it" (P.G.L.4)* • *"when Goderich had the, code orange and the, tornado, after they got themselves settled down, we then had webinar or with their staff, their what was he- it was like a Site Director or a, Corporate Manager at that time. And just what went/learning the, learning the red flags, learning what happened, what went well, what didn't go well, what would you do differently next time, you know, what should we be looking out for? And that informed our code/'code orange' when we were working on it again" (P.H.S.2*) • *"for example, not in the Pinery area, but Maitland Valley [Conservation Authority] had a tornado. The Goderich tornado went through there, Falls Reserve [Conservation Area] area. And, so after that happened, I was/I was chatting with the Superintendent and the staff and the supervisors about how they dealt with that. I know when the Durham tornado happened, the educators cause it was a child and an education day camp, that*

was killed during that event. And so the educators of the Conservation Authorities when they met, they discussed that, and how to deal with, situations like that" (O.C.A.1)

Weaknesses

- *"if something happens and you say, 'Yeah, there's not much I could've done about that.' But the reality is there's not much you can do about a lot of stuff. No matter how prepared you are and reasonably like even with prepared plans and the flow of communication, there's always going to be human flaws or process flaws" (P.G.R.1)*

- *"we heard about all types of -you know, different things and what we can expect, but to be able to bring them back and actually action them/action them through mitigation or action-/is pretty hard and complex" (L.G.M.2)*

Needs and Opportunities

- "*understanding of and respect for past hazards" (L.G.R.1)*

- *"I think the increasingly erratic climate patterns are probably one of the most significant, ways to improve, responses and different strategies. And also understanding that because of that, a lot of the stuff we've traditionally done, will not be effective, and coming to terms with that" (P.G.R.1)*

- *"I think probably a more robust data set that could be relied upon" (L.G.R.1)*

- *"I think that there is a need for, you know, consulting with broader information gathered from other sites, but then also, you know, specific information is studies done here to be able to sort of assess what's going on" (P.G.L.1)*

- *"I think it tends to be a little bit more reactive rather than proactive. So if we have a severe wind, event for instance, and then we're expected to respond to that and we have to sort of, you know, return normal operations, then we might learn some lessons from that and incorporate them into the plan" (P.G.L.1)*

- *"I think it [proactive risk management] would be practical, useful information and also proactive information. That we don't always have to wait until something happens, to learn from it, that -you know, if, an organization has had, an event happen that we can learn from that" (O.C.A.1)*

- *"we can only be so prepared- I think as much as you know, we might say we have you seen everything and we're fully prepared to respond, I question anyone that says that. We certainly have had a lot of successes… there's certainly room for growth and challenges" (P.G.R.1)*

Theme 2: Collaboration and Partnerships

Strengths

- *"quite strong, and I think because a Pinery operates very much like a municipality would just in terms of its infrastructure, emergency response and approach to risk management. And that park, in particular because of its size and use, regularly works with local emergency services, including the O.P.P., fire services from the municipal local government, Ontario's Aviation Forest Fires and Emergency Services branch of the Ministry of Natural Resources and Forestry" (P.G.R.1)*

- *"for the most part, probably other provincial organizations and- so ministries and agencies… conservation officers, the OPP… engaging with other partners through meetings and, you know, focus groups, conferences and various means like that, where that would happen" (P.G.L.1)*

- *"in the case of this park, I think a tremendous amount is being learned through academic partnerships with various researchers and universities through Southern Ontario and beyond to where, often a subject matter expert will come to us. And then over the course of, you know, years to decades, we develop a partnerships that really inform what we do… I would have to rely more on partners, specifically Wilfrid Laurier to, to help sort of inform me of/of the/the ways and means and the possibilities of that kind of (social science) information… We had a really strong partnership with the University of Western Ontario and that really changed the course of action for the park of/of how we restore*

damaged dunes and how we, you know, move people over top of them. And, and all those kinds of things, educate people about them as well" (P.G.L.1)

- *"our history of, Indigenous partnership to do with deer management. So the population of deer in the park became excessively high in the 1980s and early 90s. And since 1998 we've had a very strong partnership with Kettle and Stony, Point First Nation to implement a number of deer herd reductions and their traditional treaty-based harvests. And so we've had a fair degree of involvement with them over that time and they've assisted us greatly in managing the deer population to a more appropriate level and have seen phenomenal recovery of the park ecosystems in that time" (P.G.L.1.)*

- *"the local community, in this case Kettle and Stony Point First Nation… will either take a lead role or a support role in some different, archeological work that we would do" (P.G.R.1)*

- *"retroactively [contacted] if it's something that wasn't foreseen before, then they're engaged. That's rare, but sometimes there are groups or agencies or organizations that might not have previously had any involvement or awareness. And so they'd be engaged at that time" (P.G.R.1)*

Weaknesses

- *"non-existent" (P.H.S.2)*

- *"there is really no coordination of risk management in the region" (P.H.S.3*)

- *"lack of engagement at the local level between the province and the municipality" (L.G.M.1)*

- *"unfortunately people still work very much in silos, but it's really about breaking that silos down, and really having that common goal" (P.H.S.3)*

- *"I would say that, well- I'll just be black and white, people on the whole have not done a great job at, partnering with our Indigenous communities. So I think that/that's a way*

forward that we can go with, but it's going to take time and it's going to take building of trust between that community and everybody else" (P.H.S.3)

- *"we have several national parks close by. We meet and collaborate, minimally" (P.G.L.4)*

- *"people move on from their roles, sometimes that/that can interfere with/with partnerships" (P.G.R.2)*

Needs and Opportunities

- *"more resources [are needed] when it comes to establishing partnerships" (P.G.R.2)*

- *"we have to get together. I mean, we have to/we have to sit down and, work on this as a collective group. We can't do it individually… there's gotta be a coordinated effort" (P.H.S.4)*

- *"sort of start up a committee I guess and then start a… committee that can start looking out or reaching out to the organizations and asking for names" (P.G.L.3)*

- *"we're also looking at developing like volunteer steered groups for our properties" (O.C.A.2)*

- *"they [stakeholders in the region] <u>have</u> to include the hospitals" (P.H.S.3)*

- *"I think we need to be better connected with what the EMS or the Emergency Medical Services doing… I don't think that's very clear about- in this whole area, whether it be Grand Bend itself but the Pinery, you know, if we do have a/a fairly major natural disaster, I don't think people know what they're supposed to do or where they're supposed to go" (P.H.S.3).*

- *"Indigenous knowledge… we don't have as many -well it our/our connections to the local community aren't as strong as I would like. So I think that, that's an area for improvement" (P.G.R.2)*

- *"I'd love to learn from other jurisdictions, other park agencies, other, you know, far beyond the boundaries of Ontario" (P.G.L.1)*

- *"I think, [the regional provincial government] has already and could continue to learn a lot from the Aviation Forest Fire and Emergency Services division of the Ministry of Natural Resources and Forestry because they, you know, not to speak lightly, but they/they kind of operate almost in a military like format, where they have a lot of very rigorous protocols, training mechanisms, after action review" (P.G.L.1).*

- *"I would suggest -I've never been invited to the park to actually understand what their concerns are" (L.G.M.2)*

- *"something interesting is the Pinery as an entity isn't at this table. So it's municipalities. You know, we have these untapped things. We have these large industries or larger risks, that are/aren't at a table. And -you know, so it's kind of interesting, whereas different when I wor-/worked in Durham, we had nuclear power station, and they were at the table. Obviously a big risk. They're at the table with the municipality- they were perceived at least, as the -one of the larger risks. So it's something that could be maybe improved upon too" (L.G.R.1)*

Theme 3: Communication

Strengths

- *"part of the benefit of our diverse work is that we are able to frequently contact a lot of other jurisdictions and agencies and stakeholders and have these conversations" (P.G.R.1)*

- "*we're always talking with other parks and partners about, issues that we're having and/and solutions that we've come up with or they've come up with" (P.G.R.2)*

- *"we do have legal counsel on staff. We have people that we could consult with regards to insurance on staff and associated with us" (O.C.A.2)*

- *"so, there are, very structured, formal ways that we communicate. But there's also a lot of informal communication that happens, that often does feed into the formal practices over time" (P.G.R.1)*

- *"we're very conscious of perception, I think that's a very significant consideration in order to be able to get the message across and understand, and be able to relate to why" (P.G.R.1)*

- *"yeah, it/it's/it's, there are individuals [Indigenous community members] out there you can reach out to. I know of a few that I could, you know, that I could call and talk to about anything specific, that I would want to know background information about. But, yeah, there's, it's/it's not, there's a fair amount of difficulty in connecting. And it's/it's not, I/I can't say it's because people haven't tried, it just, - they kind of have their thing and you have to be invited to and you have/there has to be a certain amount I think of trust before you're invited. So it takes a lot of building that trust. but certainly we do communicate" (P.H.S.4)*

- *"a park like Pinery that is so prominent, especially from the local perspective,… people already know about what's going on and we're able to have those conversations" (P.G.R.1)*

- *"also [we] have our communications officer whose job is some internal communications, but also external communication. So we're very active through social media and stuff like that. So things are disseminated out that way" (L.G.M.2)*

- *"we do focus on a lot of communication, whether that's through public notices or open houses where we would offer, you know, information on not only the process of doing something… but also, on the benefits of it and the science behind it" (P.G.R.1)*

- *"Emergency Preparedness Day that I referenced earlier is a/is a huge ah- component of public ed as well. And, the other is just constantly pushing the public to sign up for My Community Notification Network, which is a public alerting system, to deal with hazards in our community" (L.G.R.1)*

Weaknesses

- *"as far as partners go, like the Pinery and that, like we just don't, we don't commu-/there's not a lot of communication… I don't think that they/they talk a lot to the municipality? I don't think they really engage… I don't really know that they/they talk that much to the communities" (P.H.S.4)*

- *"in terms of communication for other types of hazards, we haven't really had the situations where- like when the tornado nearly went through the Pinery, we didn't have any conversations with them- sort of thing, so… I would say that we don't really. We don't get together as -you know, the Pinery region is actually a/a good example because within the Port Franks area, which is right beside the Pinery, we'll have, of course the province, Nature Conservancy [of Canada], Scouts Canada and Lambton Wildlife Incorporated, we all own natural areas within this/within this area. And so we don't really meet together to talk about those things" (O.C.A.1)*

- *"the only barrier would be -again political and getting authorization to ah to- authorization to communicate outside the organization" (P.G.L.3)*

- "*has to be a two-way street" (L.G.R.1)*

- *"you can communicate with somebody, through all the different means and tactics that you can come up with, but they have to want to hear it, and they have to want to understand it, and they have to want to act on it. Right? So a lot of- there/there's a point in time where, the responsibility shifts from the communicator to the communicatee and, and you, no matter how much you want to try, we can-/we can't change somebody's will to do that. Right? That, yeah. That's something I think people are always/always gunna struggle with" (L.G.R.1)*

Needs and Opportunities

- *"from/person-to-person is always good cause you can have the conversation and/and not as opposed to just sitting down and reading it. I think that's one of the keys at/at a very local level. I think the higher-level stuff could be done more on a written type document -sort of thing" (P.G.L.2)*

- *"well, probably the best way to do that would be to have you know, a community meeting at least once a year where you would sit down with the people that are 'in the know' and have those discussions. Because right now there is no, there's nothing. So there should be some sort of a gathering. I'm as/I'm assuming- I mean possibly the Pinery talks to the municipal local government, maybe on a yearly basis. Like I'm not aware of that, but I mean, I know we're/we're not involved in any kind of discussions with what the Pinery does" (P.H.S.4)*

- *"well, at times we have it, right? And I think in/in/in all the times of those emergencies, when information is flowing well, it's always because of good communication. Right?" (L.G.M.1)*

- *"but I think where it lacks- is internally that's fine, but externally, if you know those other stakeholders are not, engaged or not communicating or you don't even really know who they are, then it's/it's bridge over troubled water because you really don't have/have the necessary people at the table" (L.G.M.1)*

- *"we don't always communicate with them- one another. You know, so I guess that's the- I mean, everybody's somewhat siloed, right? So I think that's probably a bit of an issue. Now mind you, the hospital, we actually share staff between the hospital and here. So we, we are, in with the hospital, but we've never done a joint disaster plan with the hospital [or other stakeholders]. But I think I could see that quite easily happening" (P.H.S.4)*

- *"certainly we do communicate. I know we just recently, had some interviews out in the Kettle Point area that we were doing…, so we did seek out people from the Kettle Stony Point area and had them participate in that, so we could find out, what their thoughts were. But, it was/takes a lot of work to make those inroads to you know even get in" (P.H.S.4)*

- *"social media is huge" (P.H.S.4)*

- *"well -once again, I think just, -you know, striving for consistent, one of the biggest things is consistent messaging, when it comes down to it. Striving for consistent*

messaging. Minimizing any erroneous information… I think that's probably the number one way of getting credibility is you're consistent with your messaging and the messaging is correct" (L.G.M.2)

Theme 4: Knowledge Acquisition

Strengths

- *"like any other, organization, you beg, borrow and steal the best ideas and you see what else is out there" (L.G.R.1)*

- *"we brought in, some of the subject matter experts from our local Conservation Authorities and/and coordinated presentations to be made to the local municipalities, to engineers, to planners, to building inspectors to emergency management people so that, we're leveraging the expertise of our Conservation Authorities and equipping all the local municipalities with that same base level of understanding" (L.G.R.1).*

- *"we're fortunate for the organization we work for, whether it be the Ministry of Natural Resources and Forestry or the Ministry of Environment, Conservation and Parks, who we work with, a network of people that have resources available and we employ some smart, competent people that are aware of this before we're. They're aware of the information, before we're being told of the information, which is very helpful for us" (P.G.L.4).*

- *"we would access academic journal articles, you know, on a more or less routine basis as they come across our desk that would start to inform what we do" (P.G.L.1)*

- *"our/our board of directors, they're knowledgeable people with -I would say, that community knowledge and familiarity with the/with the areas that we manage, and to know what's reasonable and/and what would work, so… taking the risk management, webinars or 1 or 2 day courses -sort of thing or/or right now, the conservation areas- a lot of the staff are at a conference right now" (O.C.A.1).*

- *"most of our knowledge just comes from speaking informally with people" (P.G.R.2)*

- *"I will be reaching out to Killbear Provincial Park as they just went through the- the beech bark disease, so/so they had to clear out all their beech, so I'm going to have to talk to them do you have it and what was their strategy and/and get it down here and have a look at it, and see if we can use it to deal with oak" (P.G.L.3).*

- *"with respect to wind, I would say, you know, they're [the public] more on the receiving end of information that's disseminated out by, you know, emergency alerts and weather bulletins" (P.G.L.1)*

- *"one of the biggest things I've been trying to do with my managers is get them to -if we can swing it, to get that overlap, so there's a better transfer of information between the two of them" (P.G.L.2)*

Weaknesses

- *"paywalled research articles, are always a bit of a barrier" (P.G.R.2)*

- *"it's just, it's not always there. What sometimes the/the information is just not there to get, and then there's all/there's/there's always/the always/ the challenge is/is, sometimes that data's not the right format and we don't have the staff" (P.G.L.2)*

- *"it's hard- because it's just overwhelming- the amount of information that's out there that needs to/to sometimes be gathered and we've got 10 other things that we're doing" (P.H.S.4)*

- *"mhm ya, well you have to know the questions to ask. You don't know if you don't know, and how do you find out and then its sometimes that's half the battle is like what is it that you want to know, again to get it- it goes back to: you don't know something you don't know" (P.H.S.1)*

Needs and Opportunities

- *"where to access it. So it's/it's/it's/it's where the access points are for the information" (L.G.M.2)*

- "*I think, probably from our point of view, is we probably don't have the information that readily available down to a/a municipal level organization… you know, our department is/is fairly thin on knowledge. I personally don't have a lot of knowledge, I'm a student of it" (L.G.M.2)*

- *"if you are aware of something, there's usually/you can reach out, and generally when you reach out, organizations with/with knowledge and expertise -for the most part, make themselves readily available or certainly play nice with you" (L.G.M.2)*

Theme 5: Knowledge Integration and Decision-making

Strengths

- *"looking first at safety and then at, the risk to the natural environment. Those are sort of the two pillars I would say from my perspective. And then, from there, there's several other risk-based considerations that would be at a smaller scale and that might include things like revenue as we do run under a business model, so how I would risk, impact/impact that and our ability to be a sustainable organization with a… cost recovery for example, park visitor enjoyment, our ability to conduct, science and research, as well as, recreational opportunities. So, there's a… multitude of things that would fall under those different scales, but essentially they would be under those topics of: recreation, education and science" (P.G.R.1)*

- *"as we learn things, we're constantly trying to make sure that we're integrating everything that we've learned, kind of collectively. That's partly my role, in that I see stuff from all over Ontario, so someone had a great idea over here, then I'll try and integrate it over here if it makes sense to do so. So just kinda managing all the information and making sure it's used" (O.C.A.2)*

- *"we are constantly, engaged with academic partners or onboarding academic progress through publications where we try to -you know, adjust our behavior and incorporate that new knowledge so that we can do a better job of protecting… So working with*

academics or attending, you know, regional conferences, those kinds of things. The ability to interact with other counterparts within the regional provincial government who are maybe dealing with the same species in a different area of their range. So there's a lot of, sort of, you know, webinars and, and means for getting that information out so that we can then incorporate it into our, our park specific activities" (P.G.L.1)

- *"I think natural science data is, makes itself pretty plain. So it's easy to incorporate" (L.G.R.1)*

- *"most of our decisions are kind of biologically-driven because our mandate is to conserve biodiversity" (O.C.A.2)*

- *"I think having like the scientific sort of, biology and ecology information- is often easier to integrate because, I would say generally speaking, it's more predictable… processes are more agreed upon and I think standards are more established, so it becomes easier for that" (P.G.R.1)*

- *"I would say that the social science aspect is a fundamental consideration that we make in all of/most of our decisions, but specifically risk management because as a government organization, we are often viewed in a very critical lens, I'll say in terms of, how we're carrying out our business and especially in terms of like how we're using financial resources" (P.G.R.1)*

- *"a lot of what goes into each decision is experience. Between myself and other staff within the park, we/so we have maintenance staff, most of them each have about 30 years' experience on the job. I have over twenty-five years of experience. So we have a fair bit of background in whether it be: how do identify hazard tree, how to address it. We have a fair bit of experience in being aware of the natural environment we work in, and how to protect it and the park users. So it's not as much of a/you don't really pull out the binders to see what you're supposed to do for hazard tree" (P.G.L.4)*

- *"at things like reversibility as well. So, can the action that we're taking now be modified or reversed if it's not deemed to be the most effective course of action, in the future… because we're a part of the provincial government- any political considerations that we might need to have, in terms of what we're doing and impacts to provincial resource, local economy, that sort of thing" (P.G.R.1)*

Weaknesses

- *"I'm not aware of any barriers [to accessing social science information]. It's probably just something that… It's just not done that often, I guess" (L.G.M.1)*

- *"not my area of expertise, but I would say social science is more of an opinion… And that's much harder to defend" (P.G.L.2)*

- *"the traditional knowledge, just being traditional knowledge -lacking statistics, and lacking reports and stuff like that. So, it's anecdotal-kind-of storytelling" (L.G.M.2)*

- *"Indigenous knowledge for instance would be very site specific and community specific. They may have nuances that, you know, apply here but not down the road at another site" (P.G.L.1)*

Needs and Opportunities

- *"so much of managing a park, that's as busy as Pinery, is managing user behavior, and the social sciences are our best tool for that" (P.G.R.2)*

- *"I will admit that I have a bias towards natural science. It's my background. I have, you know, two degrees in based in/in natural science. And so I think it's an area that I'm just more experienced with and more familiar with. The social science stuff is really quite foreign to me" (P.G.L.1)*

- *"so, I would have to rely more on partners, specifically Wilfrid Laurier to/to help sort of inform me of/of the/the ways and means and the possibilities of that kind of information… I think also just the history of protected areas where they sit within government ministries has always been more closely aligned with sort of natural sciences and*

resource protection, as opposed to, you know, for instance, social science, which is, you know, a much newer area. And I think because of that, there's a level of comfort with a lot of the employees that they understand and are more familiar with natural science-based information and some of the things like social sciences, just a little bit more novel and it takes longer for them to sort of - you know, accept maybe or to understand the full potential for that kind of information" (P.G.L.1)

- *"[the regional provincial government] usually has a very good working relationship with First Nations. So that's/we usually can access them and then they will tell us their stories and/and/and that sorta thing. Sometimes it's a matter of how do you in/in/interpret that information. But, I would say probably the biggest thing is it's not in the forefront of people's mind, of something to go and get" (P.G.L.2)*

- *"in some areas, I do suspect it [Indigenous knowledge] is incorporated in/ah this time. From my own perspective, it's not ah/it's not a large component of- it might just be a matter of/a matter of time. So if anything, how will that someday become more part of the decision-making process? I think it's a somewhat of a personnel, their own preference for how they obtain information and how they utilize it. I can anticipate in some areas, staff in the same type of position I have, utilize Indigenous knowledge in a maybe a more proactive way and would make decisions based on that. At this time though, it's here locally, it's not used much" (P.G.L.4)*

Theme 6: Knowledge Sharing and Exchange

Strengths

- *"provincially we do share some things with/so there is some inner ministry kind of things now, especially with us out of Ministry of Natural Resources and Forestry now, where we have to work with them closely on some things. So there is some information that has to go back and forth between our Ministry and their Ministry, and the conservation authorities, and things like that" (P.G.L.2)*

- *"from an organizational standpoint, our branch office in Peterborough would disseminate knowledge at a higher level to generally different levels of government or relating to, our protocols and, any occurrences as well, like a summary of occurrences" (P.G.R.1)*

- *"we have an Association of Fire Chiefs and then I can draw upon all types of/of information. We meet fairly regularly and stuff, so we don't have to reinvent the wheel. There's similar circumstances, in similar places. And -you know, once again, drawing on that knowledge is makes things/life easier. And the fire service's, is/is an excellent-/we share everything. We steal from everybody. We share everything. There is no/nothing is sacred in our service" (L.G.M.2)*

- *"we share within the [the regional provincial government] organization. Yes" (P.G.L.4)*

- *"I know there are a few places where we have, information sharing agreements between a university and/and ourselves, or between us and a conservation authority, and that/there is some of that, that goes on" (P.G.L.2)*

- *"message[s] would come, through more, direct channels to park visitors such as like signage or, you know, sometimes we'll do newspaper ads or word of mouth communication depending on what it is, as we often have control of entries into parks, so we're able to provide that type of information" (P.G.R.1)*

- *"web presence: Facebook, Instagram, and I think that's all the municipality uses, from a/from a social media, but the/the very active, probably -you know, could you say we limit ourselves to -I'm going to say 2 or 3 posts a day, but they're preplanned, they're canned, they're ready to go, they're appropriate -you know, they're thought out. We have a proper communications person, that -you know, thinks out when you want to hear this, when you're going to meet your/your target launch, and we have a relatively okay following" (L.G.M.2)*

- *"I'm going to say- its either I pick up the phone… or send them an email saying this is what we're dealing with so and I guess then if I need assistance they may come in or they*

may offer assistance… -it's shared -like documents are shared around, -and-are we do get together meetings regularly, so if an incident happens here, we share those experiences with other park superintendents within the organization. And/and information is always flowing out" (P.G.L.3)

- *"wind events, which, you know, we do have, one example, years ago we worked with Environment Canada to develop up some fact sheets on severe weather and camping safety, which have proven to be very helpful. We post them throughout the park and on our websites. So that was a great partnership where we sort of went to the experts and said, 'What can you advise?' So what do you do in the event of a severe thunderstorm or high wind if you're outside without a building or vehicle or those kinds of things" (P.G.L.1)*

- *"I think for the most part, scientific-based knowledge and stuff, is the easiest. It's the most acceptable. It's, the bureaucracy seems to work best on that" (L.G.M.2)*

Weaknesses

- *"I'd say at this point it's not done [knowledge is not disseminated to partners in the regions collaborative efforts to mitigate natural hazard risks]" (P.H.S.2)*

- *"we work closely with all of these groups, closely and very regularly, but as for how do we share information, it's more of a working relationship as opposed to a reporting to relationship. We don't share much data with/with them" (P.G.L.4)*

- *"I think because we have a large senior population, it's really hard to get them involved in new technology. So, you know, a lot of times we want to use email, we want to use social media to spread our message and to get input and so forth. But because of the population and demographics that we have here, we just can't do that. So that is a barrier for us" (P.H.S.3)*

- *"this year [2019] there's been a restriction on travel, so we haven't been able to go to as many meetings as previously,… so there hasn't been as much of that the last year or two.*

So I think people are trying to shift to like webinars, things like that, but there isn't as much discussion involved" (P.G.R.2)

- *"it takes forever to get approvals to-to be able share that stuff [risk management knowledge]" (P.G.L.3)*

- *"there are elements where information is sensitive and you/you need to think twice before you disseminate it" (L.G.R.1)*

- *"different privacy concerns" (P.G.R.1)*

- *"hesitation [related to] sharing things with the government because, then it might become public knowledge" (P.G.R.1)*

- *"I would say that's the bottom line is people don't like to share. Knowledge is power, so they don't always like to share the information. I would say sometimes there's confidentiality, things that get in the way of being able to share, or other people don't want to share it because they think it's top secret and, 'If I give it to that person, they may tell somebody else, then it's not appropriate.' So I think that kind of stuff too happens a lot where it gets bottled up because they don't want to share" (P.G.L.2)*

Needs and Opportunities

- *"we're finding people are getting over, inundated with emails and that you're not going to check websites and they're not gonna check blogs and you know, blogs are done, all that kind of stuff. You have to have face to face, and you have to have networking, and you have to know people that you're working with and trust the people that you're working with. So it really is about touching the people that are involved, navigating through the system together… networking, reaching out, familiarity, attending meetings-if they're held" (P.H.S.2)*

- *" -quite honestly, just the/the/the/the formalization of knowledge sharing groups. So, for example, if we could sit down with parks on an annual basis and look at their emergency plans, look at ours, talk about issues" (L.G.M.2)*

- *"pooled knowledge is always/you're always more/you're always better equipped when/when your stakeholders are at the/at the same table and willing to share the same level of information that you're willing to share, just helps you understand each other's processes and hazards much better" (L.G.R.1)*

- *"I think it's honestly sharing the information. Right? Like a lot of times people do stuff and we never see the end result… We see that, oh, we have this great report. That's great. Checkbox- it's done, and then we don't see anything else from it. So it's about taking the information, actually doing something with it" (P.H.S.3)*

- *"from an academic side, you know, just appropriate reporting and sharing of knowledge. There is sort of a nuance where a lot of the people who work in parks, maybe not used to reading academic journals. And so it might require sort of some gray literature publications that come out of, primary literature" (P.G.L.1)*

- *"when we speak to, like our physicians, evidence and facts is what speaks- right?! Whereas when we talk to the general public, we try to use storytelling, as more of an approach. So it's a little bit of both. Sometimes- again, people want to see both. Other people don't want to know the facts, they just want to know sort of the outcome or what's the story you're trying to tell. So again, it's depending on the audience that you're trying to meet with" (P.H.S.3)*

- *"we're beginning/better at evaluating what we're/we're doing (education), some trying to get down to/to understanding how effective some of these things are and some things aren't very effective, but we still do them because they're easy. Some things are more effective, but they take a/a lot of work to do. So we're/we're becoming/we're catching up, with the industry of where we need to go" (L.G.M.2)*

- *"we are progressing quite a bit and I certainly like from 1996 or even, you know, 15 years ago, I've seen, like an exponential increase in how we're using traditional ecological knowledge and social science" (P.G.R.1)*

- *"support, certainly from like the, the provincial government" (P.G.R.1)*

- *"things like traditional knowledge is a bit trickier, because we wouldn't want to overstep. So again, when we can share directly, something that someone else has put together, then we would definitely try to do that" (P.G.R.2)*

Theme 7: Planning

Strengths

- "*hazard plan (was developed) specifically for, tornadoes and in severe summer weather events because that is probably the highest ranking risk/well, it is the highest ranking risk for the municipality. So, we plan for those… In general, yes, we do. We/we make/we make plans for the hazards that we can prevent and mitigate and the ones that we can't prevent and mitigate and we prepare for" (L.G.R.1)*

- *"the regional local government meets four or five times a year with the, with the, Emergency Management Coordinators of the local municipalities. We talk about different risks in the community, different initiatives to prepare, and planning against risks" (L.G.R.1)*

- *"we're constantly looking at different appendices that will support our senior staff in dealing with an emergency. And one of our appendices is our/is our Hazard Identification and Risk Assessment [HIRA]. And that is evaluated every year by our Emergency Management Program Committee and to look at different risks in the community and make sure that we're still planning for the risks that pose the biggest threat" (L.G.R.1)*

- *"I think it (natural science) plays a very relevant role, right? Because it helps, helps you to plan" (L.G.M.1)*

Weaknesses

- *"we don't even know who our visitors are" (L.G.M.2)*

- *"I would say that really we aren't doing it to mitigate natural disaster risk. I would say that's not been a focus at all- of this centre at all" (P.H.S.3)*

- *"as far as, planning for the risk- we haven't gone to that level" (P.H.S.2)*

- *"I have been with you know parks for over 30 years now so, an-you it seems that this organization or we/we/we are not proactive we are reactive, so if it happens then we can deal with it and ah ya we are very good at it" (P.G.L.3)*

Needs and Opportunities

- *"whenever you're doing your planning and management it is to have that clear goal or what are your objectives. And I think that's when you would tailor to what types of information that you would use to make your decisions or make your plans. So again, it's looking at what the evidence is, out there, how does it support what you're trying to do- exactly like what you're doing here. And moving forward with that" (P.H.S.3)*.

- *"At, at our level, at the park, I'm not aware of anything that's being done to sort of assess it from- again, there is probably some reactive response…, but I'm not sure that that has gone into our planning at all. It would just be sort of that we might get more familiar with dealing with reacting to climate based issues? Because they are happening more frequently and so we change our response to/to match that need, but I'm not sure that we're doing it proactively" (P.G.L.1)*

- *"so when we are planning our- we'd have to do mock/mock codes. When we would be doing a mock 'code orange,' we would think about what kind of demographics would come into the hospital as a result of the injury. So we know that our area has a lot of seniors. So we talk about our/our long-term care homes. We would talk about- we know that there are, I'm not going to call them trailer parks, but res- areas where there are*

mobile homes in/in small areas. we know/you know, that there are often a lot of young people in the Pinery or so, we would think about those kinds of things when we're thinking about our response. But as far as, planning for the risk- we haven't gone to that level" (P.H.S.2)

- *"yeah, well, risk management, we do have- you know/like I say, we have frameworks, we have/we have, we have knowledge of mitigating all kinds of risks, especially with respect to healthcare, so we would be valuable in that capacity if they, if they wanted that" (P.H.S.2)*

Theme 8: Plans, Policies, and Regulations

Strengths

- *"we create a plan for every one of our properties that we own, and that includes a review of/of what we call liabilities on our property" (O.C.A.2)*

- *"I would say most of the stuff that comes out of that is/is done in a policy procedure type manner. So if you were to/if we've deemed there's a certain thing that a/a/at risk hazard tree, then there's policy procedures about, 'You need to have a hazard tree assessment program in a way of dealing with this in your park. Our emergency management stuff, you have to have a site-specific Emergency Management Plan. These are the things it should include, this is how you go about doing it… There's specific policies, procedures onto: here's how it has to be, these are the things, there's like weekly checklists that the staff need to complete, those sorts of things" (P.G.L.2)*

- *"on Wednesday [2019] I did an actual presentation on our plan to all staff, which is the first time I've done that. So they understand that the plan exists, that they're legislatively covered and how we would act in a certain response or situation" (L.G.M.1)*

- *"there's mandatory exercises that you have to have every year, there's mandatory reporting- what's called a compliance tool, it's legislated- you have to report every year. So, no- these are the things that we're/we're working through" (L.G.M.1)*

- *"every year the regional local government does an emergency management exercise and it's based on the hazards we've already identified. So we practice our response to different hazards" (L.G.R.1)*

Weaknesses

- *"I don't even know if we have one [Risk Management Plan]" (P.G.L.3)*

- *"[pause] -I don't know" (P.H.S.4)*, when asked if their risk management plan specifically addressed wind-related events or tornadoes, "*I don't know because like wind isn't even one of them. Which it's interesting after talking to you guys, I thought we need a policy on where do we go in the building for tornado, which we don't have" (P.H.S.4)*

- *"And, another significant barrier is we are, required to abide by a lot of, legislation, policies and procedures that sometimes can be restrictive in terms of, you know, what we can [laugh] do and how we're able to do it" (P.G.R.1)*

- *"and I think that people get caught up in some of their mandates that they have to have. So you have to have certain reporting at certain times, so people will push ahead to meet that deadline" (P.H.S.3)*

- *"I think once you get into the business of/of compliance reporting to the province, you end up, if you're not careful, you can end up with municipalities that manage their program to meet compliance, rather than manage the program in the/for the best interest of the community" (L.G.R.1)*

Needs and Opportunities

- *"prior to two years ago, there wasn't a formal [Risk Management] Plan" (O.C.A.1)*

- *"well, we don't have a separate risk management plan. I would say it's that's rolled into our Stewardship Plan for each property" (O.C.A.2)*

- *"see and/and to me an Emergency Plan is the/is the reactive things that we have and/and/and/and that. The Risk Management Plan on/to me on the other side, is kind of the/the assessment and: can we/what can we do to mitigate this? What can we do to put plans in place and proactive? So I would say they're/they're two different things, but I/I don't think that's necessarily the norm, the way people would/most of the field staff wouldn't think of it as that way, they're like, 'I have an Emergency Management Plan. This is how I deal with risks in my park…' Again, it's the/it's the risk management side of things that I think we struggle with a little bit to/to try to figure out that versus emergency management" (P.G.L.2)*

- *"we're not aware of Pinery Provincial Parks Emergency Management Plan. Right? It's not in [the binder]. So it would be nice to know what's in their plan because guess what, we border them and you know, but right now there's a bit of a disconnect because they're here, we're all around them. We don't have their plan. I don't even think they have our plan, but they could access it if they needed it" (L.G.M.1)*

- *"I think just the general sharing of our Emergency Response Plan with local municipalities and with the province- that's a huge step" (L.G.R.1)*

- *"I would say that a great- is needing to know what everybody else's plans are. Like you're really- cause I could not tell you what EMS's plans are or what the municipality plans to do. I don't think those are shared widely with anybody" (P.H.S.3)*

- *"but right now there are plans, but, we're not, I'm sure there are plans at municipalities, but they haven't reached out to us and we have reached out to them to be included" (P.H.S.2)*

- *"I think we need to together as a group and come up with/with an overall plan. And, I can certainly see that, the Pinery would- I can see their concern. It's a big park. It's huge. There aren't that many places for people to kind of hide. If there was a situation and then to have all those people into town at the same time. Yeah, there's gotta be a coordinated effort" (P.H.S.4).*

- *"we do have excellent reaction-type plans to -if we get hit by a wind-event, here's some things we have to put in place, here's what we have to do" (P.G.L.2)*

- *"the impacts of climate change? Not the- the plan specifically doesn't reference climate change as a/as a phenomenon, but the- I think the understanding of/of climate change is/is reflected in/in the risks that we identify and plan for each year" (L.G.R.1)*

- *"yes, it [Risk Management Plan] does take into consideration the impacts of climate change" (P.G.R.1)*

Theme 9: Relationships

Strengths

- *"there is a very strong sort of family-based approach within this organization" (P.G.L.1).*

- *"they/they trust us by re-/repeatedly entering the premises. The park users here currently today, have all been here before. If they didn't have a level of trust, that we would look after their safety of person and property, they would likely not return or they would likely make others aware that the park is unsafe or untrustworthy" (P.G.L.4)*

- *"I think they do think of us as a trustworthy organization. I mean, there's also other places where we're dealing with other stuff that would/they were like, 'No, you're the government, you're lying to us. This is…,' and that, but all in all, I would say -yeah. [The regional provincial government] is/has a/a/a good reputation outweigh, and just because of the type of business we're in, people are/they're generally happy to come on: holiday, and vacation, and spend their time with us, so you kind of naturally flow into that" (P.G.L.2)*

- *"it's a superintendent's responsibility to, establish a relationship and communicate with, local emergency services, municipalities, relating to operational aspects" (P.G.R.1)*

Weaknesses

- *"turnover of personnel… police [for] example, if the local Sergeant were to retire or move on, we may have an excellent working relationship with them along with the other staff. But when you/when personnel changes happen here at the park or with the local, group of some sort, takes a bit of time to form new relationships, to share that information in such an easy, smooth way" (P.G.L.4)*

- *"I think in the traditional ecological knowledge, realm, in my experience, it's only really effective when you have a relationship with the community" (P.G.R.1)*

- *"confounding issues that come up that strain relationships and make it more difficult to access some information. So it's very hard to be moving ahead on sort of Project A when Project C is/is in a, you know, point of conflict perhaps" (P.G.L.1)*

- *"well, we don't have as strong of a relationship with Parks Canada, as we probably should" (P.G.R.2)*

- *"potential for us to share our sort of, you know, collective experiences of how we have managed to this point dealing with, scenarios where we have large levels of the public involved- at various times of the year" (P.G.L.1)*

Needs and Opportunities

- *"for a year -say, so, I'm not expecting that we'll be fully integrated into every community group and understand all of the/the needs and able to tap into all of the knowledge that exists for possibly 5/10 years -who knows" (O.C.A.2)*

- *"I used/we used to have a very sort of close relationship with the librarian for the Ministry of Natural Resources and Forestry and you know, we're, we're trying to reach out to the counterpart in our new Ministry Environment, Conservation and Parks, but just haven't built up that relationship and process quite as well yet" (P.G.L.1)*

- *"I think that the parks [Pinery Provincial Park] need to reach out, and get to know their communities they serve" (P.H.S.4)*

- *"well I think we try and have as many activities as we can where we are 'open door,' so that people can come and/and feel, you know, that they can participate" (P.H.S.4)*

- *"continuing to be open and transparent with what we're doing, and why we're doing it" (P.G.L.2)*

- *"I think that it really, it's/it's a bit tricky, but it requires relationship building with specific [Indigenous] individuals in their communities, to build up a degree of trust where they feel comfortable sharing their knowledge. So that, you know, has, you know, taken decades of work by individuals in this park to sort of build-up that level of trust and then there's, you know, sharing of their knowledge. So that's a/a key sort of long-term commitment by [the regional provincial government] to be supportive of their community and to engage with them. There's certainly a lot more that can be done obviously, that we need to work on. But, yeah, I'd say that/that's a key thing. You know, just having us able to work with them over multiple iterations of this management process, they've sort of become more comfortable with us and have a better understanding of sort of how we operate this/this program and through that, you know, some information has flowed to us" (P.G.L.1)*

Theme 10: Resources and Capacity

Strengths

- *"I think it's also very helpful that, [the local provincial government] in particular and [the regional provincial government]in general are, significant areas from an emotional standpoint for a lot of people. So it's a common, and public resource that people care about. So it becomes easier to access resources to protect and operate these areas versus something that might be more of like a private interest that people may be less willing to participate in or allocate resources to" (P.G.R.1)*

- *"we have a whole library and/and suite of resources for natural resource research and decision-making. We have a, ministerial library, we can access for that kind of information. Yeah, we're very fortunate to have lots of resources" (P.G.R.2)*

- *"[the] biggest benefit [of] [the regional provincial government] is that we have a very large staff base in a very large land base and varying experiences to draw from… we have access to a lot of resources and we do have a lot of capacity in terms of staff. We have, biologists that not only work at the park, but also work in this office, as well as, planners that work in this office, land specialists, operations specialist as well. So and naturalists and interpreters, so quite a robust complement… I think there is a conception- based on my experience, that [the regional provincial government] and [the local provincial government] in particular has a lot of that covered or has considered risk management" (P.G.R.1)*

- *"prior to that, another tornado- an F2, struck part of the park and hit the Grand Bend area. We treated it here locally in the park as a local issue. we looked after it ourselves- staff mobilized, dealt with the situation. We probably would have had 10,000 trees come down, many of which the size of this building or just a pile of sticks thrown in together. We had several of those large blow downs through the park, but we/we dealt with it fairly well" (P.G.L.4)*

- *"just past experience, and its work experience, I have been with you know Parks for over 30 years now" (P.G.L.3)*

- *"training is continuously available for staff on/on, a/when a new hazard is identified, we share it with the regional office, they share with a branch office, and then that information is passed along to staff, in all areas" (P.G.L.4)*

- *"I have been very fortunate in and is developing relationship with the local or Indigenous relationship, so and quite often I've already- people come to me cause of the training I've had, so I work with the Ontario Provincial Police [OPP] so that they have provincial liaison team, so I work with them a lot, I had- I've taken their courses and*

their training. So that's managing anything dealing with if it's an issue with Indigenous community, its considered -ah high risk, and so like I said I've been fortunate to have had a lot of training with outside organizations and able to deal with that so, from time-to-time I will get called upon to help negotiate or talk" (P.G.L.3)

Weaknesses

- *"we're always a little bit fiscally constrained. So there's certain things that, managers are/are very concerned about -you know, you can only do so much with the given budget that we have, but I would say in most cases were quite/and try to be proactive about, about risk and/and at handling risk, but it's a/it's a challenge in a big park" (P.G.R.2)*

- *"there's obviously cases where our properties are neighboring other conservation lands, and we'll work with those other and managers to make sure we're as coordinated as we can be. In practice, that can often be challenging because one year we will have resources, but they don't, and another year they'll have resources, but we don't" (O.C.A.2)*

- *"arguably, time might be our barrier" (O.C.A.2)*

- *"no one has time [laugh]. Everyone's busy. Everyone's trying to do the best they can" (O.C.A.2)*

- *"time… and resources. Like that, the actual having, we don't, for example, have a risk management staff member/person. I, it's on, it's off the side of everyone's desk… we have nobody that is 'risk manager.' Is small/very small organization only 19 bed hospital, independent of no other, no independent of its of other partners. So, barrier is time and resources-and human resources" (P.H.S.2)*

- *"I am the only full-time employee, everybody else is volunteer" (L.G.M.2)*

- *"I guess the only barrier sometimes is we're, we're a small organization. We have- I think we're just under 50 employees… and there's a small management team. We all wear- twenty different hats" (P.H.S.4)*

- *"I'm sure they [risks] do [vary depending on the season], but we don't have the capacity to necessarily manage as precisely as you might hope for… we/we have/give-or-take two full-time conservation biologists that are responsible for all of our properties from Niagara to Pelee Island, so they can't be everywhere after everyone wind-event or after every ice storm or after every tree may or may not have fallen over" (O.C.A.2)*

- *"I think the number one problem would be, resourcing. So there's just not enough of us employed for a long/long enough time period. A lot of our staff are seasonal because of that fact. We have some who stay with us for years and years, but others that are quite a femoral and move on to try and find more secure employment. And so there's a high degree of turnover and just, you know, having not/not having sort of a lot of human resources, means that we often are just sort of accomplishing the/the mandatory requirements to operate the park. And some of these things that we know are sort of, you know, in our best interest- don't always get the full time and resourcing that they deserve" (P.G.L.1).*

- *"unfortunately we don't tend to have too many social science experts around in our/in the park" (P.G.R.2)*

- *"social science information that you mentioned. It/because it's so dynamic and we don't have the type of dedicated resources that we do for like the other sciences in many cases, that it's one of the bigger gaps that comes to mind" (P.G.R.1)*

- *"we are active on a number of platforms and, to be honest, this is an area that I personally feel a lot of, risk pers- like personal and so, organizational liability risk because we don't have the resourcing to be able to consistently respond and share information [on social media] about risk" (P.G.L.1)*

- *"quite honestly, First Nations communities are so fricking consulted on everything… they actually have a capacity issue and can't actually be consulted. So while all of us government agencies, and I'm sure parks are the same -though I don't know that -you know, we reach out and we do our 'consultation' with them. It's not true consultation*

because, with all three levels of government consulting on, there's no capacity there. There's not the/the ability to actually, for them to meaningfully think of" (L.G.M.2)

- "*I think about our relationships with our local, we're lucky that we have the Kettle and Stony Point First Nations nearby. And the challenge is their capacity to get involved with things that really aren't of their core mandate or interests. Like they have so much on their plate as a First Nations community" (O.C.A.1)*

Needs and Opportunities

- *"well it's kind of a boring copout answer, but with more money, and therefore, more stuff, we can always do better jobs" (O.C.A.2)*

- *"a lot of the staff are retiring now so we are losing that knowledge, so/so we are trying to get it- to get it documented, so write down what they know and- past history that sort of stuff so it's always available to future managers coming in… it's not always possible cause of financial reasons were if your bringing somebody else- their replacement to work side-by-side, but usually it's because of financial reasons their out and their replacement starts the next day so, so and that's where the documentation comes in then- because they gotta sit there and read and learn it" (P.G.L.3)*

- *"because we're so short staffed, we can't be fully integrated into every layer of society or communities, in which we're working. And we're slowly getting better at that, we used to be quite centralized and now we've got staff spread out across the province a little bit better. So we're much better able to take part in local events that are run by other organizations and things, to better understand the needs of communities" (O.C.A.2)*

- *"we've had one tornado event in my time here in this park that was obviously, it/it was in, I think it was July… So there's certainly variability and our ability to respond because our staffing levels fluctuate so much over the course of a year. Is/is drastically different. So in the summertime we tend to have a lot of resources, but we also have a lot of public. In the winter time, we tend to be a lot lighter on staffing resources but have fewer visitors in the park" (P.G.L.1)*

- *"I think internally for us more training and, equipment for staff would be really helpful so that we can know how to respond, when to respond, all those kinds of things" (P.G.L.1)*

- *"forum, for risk management education and training and upgrading and things like that. The/the challenge that I find, is that there ar-/there are companies out there that sell those services and I need to be able to weigh what services are -you know, how are they accredited to provide those services? … I think there's an opportunity there to/to, advance that further" (O.C.A.1)*

- *"I can't see of any great barriers [of more fully integrating social science, traditional ecological knowledge, Indigenous knowledge or other forms of local knowledge, into parks planning and management] besides capacity to do it" (O.C.A.1)*

Theme 11: Responsibility

Strengths

- *"it comes down to what level of risk am I willing to accept, or my boss willing to accept on, on behalf of [the regional provincial government], to say, 'I'm comfortable with that.' I can defend that to the director or to the premier, and say, 'This was my rationale and I'm good with that,' so that's more the role that I would play in that is/is, yes -I'm comfortable when they come and say this is what we're going to do and -yeah, I'm comfortable with that level of risk" (P.G.L.2)*

- *"I oversee the hazard tree management program throughout the park. There are over +1000 campsites that people camp at, each year. We have an arborist inspection of each campsite and the trees surrounding the campsite, essentially looking at a one tree distance away from campsites. Any known hazardous trees, we close the campsite if we need to, or we use the norm/more common approach: we have the tree removed. We/we'd cut the tree down- do the tree cleanup, so that the area's safe. We document those inspections, even if there's- front campsite number #722, and there is no hazards, we document: time, day, person who inspected it, and then we have our park staff continuously inspecting trees. I oversee that to ensure that it's done in a reasonable way*

to manage general liability. If a park user informs us of a hazard tree, we will have knowledgeable and capable staff go down, inspect the tree and make a determination as to whether or not it's a hazard, whether or not it should be cut down, whether or not they [park user] need move off of that campsite right/right away or whether they may be able to remain. I make the decision if/if it's determined they must move, then they must/they must remove that/from that campsite" (P.G.L.4)

- *"the [regional local government] level, it [risk management] is a full-time responsibility" (L.G.M.2)*

- *"outside of the park- if it were to be a severe emergency, that's Emergency Management Ontario. They would/they would mobilize and they are in charge. They would become in charge of this park as well, if there was a/a serious enough emergency, that local people couldn't handle themselves. In a situation that's not so severe, we worked with EMS on almost a daily basis, not so much this time of year, through four months of the summer, we work with EMS almost daily, the volu/the local volunteer firefighter crews are in here regularly. We have an Emergency Response System that is well practiced, well utilized, and we have experienced staff that can lead through an emergency quite well. If/if we cannot, then the OPP [Ontario Provincial Police] would be brought in to lead it on our behalf. That would be a regional wide emergency on a local issue" (P.G.L.4)*

- *"we do stress that it's everyone's responsibility in the organization to know what, at least what we know and what we have, in place [concerning risk management]. It's the responsibility to know it and we can educate and do education and hold, you know, quizzes and things like that, so that they're keeping it in their mind as much as they can" (P.H.S.2)*

- *"park staff are informed that if they become aware of a hazard, that they must inform their supervisor… The supervisor's aware they need to have that addressed. So there is a small reporting system in place, and then there's- for higher level staff, they need to be aware of the overall impact and how to address it" (P.G.L.4)*

- *"we have a responsibility under our plan to engage the public and provide them with information. Educate, you know, trainings internal, it's legislated as well" (L.G.M.1)*

Weaknesses

- *"in terms of Nature Conservancy or Lambton Wildlife or ourselves, we don't really do anything to say: if it's windy, don't come in our property- sort of thing -you know" (O.C.A.2)*

- *"I think so. I think that a lot of people come into parks and they have an expectation that a park ranger- man or woman, will come and rescue them if they have trouble. I struggle with this a little bit because it's, I don't think we always can live up to that expectation and I'm not sure that we should. I think that a lot of people go out into areas maybe a little bit, you know, ill-prepared and not equipped to deal with situations and maybe rely too heavily on, park employees to come to their rescue. So, you know, do we have appropriate resources to deal with every situation? No, certainly not" (P.G.L.1)*

Needs and Opportunities

- *"on a minor scale, like the/the parks are always everyday printing off the weather. If there's special weather reports that are coming up, there/they try to make sure people are aware in their regular duties. We don't go out of our way to promote that or drive around with a loud speaker or anything, but they do post that information. They do when you check into pick up your permit, they'll/they'll tell you, 'Just, oh- by the way, there's a severe storm warning out for today'" (P.G.L.2)*

- *"continued proactive, hazard mitigation and communicating of hazards. Some of the hazards cannot be removed. There is a shared responsibility to take care of themselves. They are camping in a forest, they accept some of that risk them self. We accept some of that risk on their behalf by taking reasonable approaches to protect their safety of person and property" (P.G.L.4)*

- *"I want to get this in here, the whole challenge is, of, people accepting responsibility and to educate themselves as they go onto a piece of property" (O.C.A.2)*

- *"another form of risk management, is us trying to work out what do we need to do in terms of due diligence to make sure that these volunteers are working safely on our property, to create a trail for visitors -to our property. So it has this whole layering of/of liability concern that one might have" (O.C.A.2)*

Theme 12: Risk Monitoring and Evaluation

Strengths

- *"we commit to monitoring our properties from a safety perspective… we do commit to checking up on trail safety, particularly after some kind of relatively unusual weather event. So, in Spring when our field staff get back out, then obviously we're expecting to come across damage from Winter weather and that kind of stuff. And some more like we have, you know, a colossal thunderstorm or some kind of unusual weather event during the growing season, then we'll do our best to get out shortly after that as we can. We also rely on the public to let us know if they come across a problem on our properties" (O.C.A.2)*

- "*climate change has been a factor within that -sort of thing as/as we have changed. So/so that has increased our risk inspections as well… as our rainfall patterns are changing,… the inspections… have had to change. For example, the/the damage that flooding can do, -that we now get Winter rains. Whereas before I would say that, 'Okay, this trail at Bannockburn [Conservation Area] for example, that trail is basically going to be the same throughout the Winter.' But now if I get Winter rains, and we get the February rains, in that I need to inspect that after a February rain because there can be damage to the trails and to the structures and things like that" (O.C.A.1)*

- *"we participate in monitoring efforts" (P.G.R.2)*

- *"so park staff, do daily checks of the park in terms of regular patrols, whether it's for enforcement or maintenance" (P.G.R.1)*

- *"I implemented a project here called the Photomon Project, which is a long-term citizen science based photographic monitoring of environment. So there's posts throughout the park and the public, participates by snapping pictures and submitting them to us. And so that would allow us to document photographically document change in the environment, which may potentially one day play a role in how we might respond or you know, being able to sort of assess changes… that resource is meant to try and equip, you know, us today, but really future managers with a dataset of observation so they can see what the park was like at this time period and be able to compare and contrast that in the future" (P.G.L.1)*

- *"we have a, a myriad of data from other parks… throughout the province and specifically throughout this region" (P.G.R.1)*

- *"so I think for us it's a/as technology advances in terms of computer technology and GPS and all that sort of stuff, that's made things a lot easier to log where hazards are" (O.C.A.1)*

- *"a big part of risk management inspections would be identifying hazard trees, that are close to the trails and then cutting down those hazard trees. So that's, we don't cut down live trees and we realized live trees can fall during a tornado too" (O.C.A.1)*

- *"certainly there's stuff like ongoing hazard tree assessment. So that happens on kind of a year-round like routine basis that if there are trees that are deemed to be at risk of/of coming down or they look unhealthy, then that would be something that's done on a routine basis" (P.G.L.1)*

- *"I mean, if we find a/again to focus on the wind thing, if we find a hazard tree, then we'll find the safest way to deal with that hazard. And if that creates another hazard, then we'll deal with that, as well. So you take a tree down, that pulls another one over, then we'll deal with that too… if we see a forest that has a high Ash component, or soon a high Beech component, or a high component of other trees are about to die, then we'll either commit to monitoring it more frequently until a point where we have to decide to*

close it, or hire a contractor to come in and take out the things that are obviously hazardous" (O.C.A.2)

Weaknesses

- *"when the tornado hit here, I happened to be at my residence that evening, but I was tracking the weather situation. I had staff here and was getting updates and I sent out a notice that arrived basically at the same time as the tornado hitting. And there was some negative pushback saying, 'Well thanks for the notice, but it just happened'" (P.G.L.1)*

- *"I think the answer is probably not at present... we are just dabbling in collecting any data at all, on people visiting our properties. We have some trail counters up in a couple of places, so we're starting to understand -you know, how many people actually go there… I know there's a bunch of apps that are more specific to: trails, and trail use, and hiking groups, that we should be tapping into, to get exactly that kind of information" (O.C.A.2)*

- *"we were able to look at things like, erosion levels of so many meters/per year is what was expected, and we're seeing far in excess of that. We've got a bigger problem, we need to readjust the way we've been thinking about this, and/and that's, but so those came from engineering reports and things like that. So I think we do use that kind of data when it's available" (P.G.L.2)*

- *"for some scenarios, that stuff's just not there" (P.G.L.2)*

Needs and Opportunities

- *"I would say just any continual improvements in information that's/that's out/that's available on/on hazards and the impacts they could have on us" (O.C.A.1)*

- *"I would love to be able to survey park users and say, 'How would you want to be notified if there was this severe wind event happening?'" (P.G.L.1)*

- *"a data base available where everybody has access to it and they could input it- ya well I'm trying to think we're trying to get into—I sat on [the regional provincial government]Health*

and Safety committee and-and so when incidents happen, it's all recorded on paper, but I always say there should be a data base we can go in and just key that stuff in and then the stats are collected and then complied" (P.G.L.3)

- *"I think you're always as good as your data, right? So if your data's not maintained or kept up to date, then you risk somebody falling through the cracks. And that's one of the things that/that still has to be ironed out" (L.G.R.1)*

- *"forecasting probably would be a key one because we, you know, we have a, you know, situation here where we have potentially 10 to 12,000 people in this park. And sometimes, we're finding out about risk as it's happening… So knowing further in advance, that there's going to be an issue, would really help us to be able to better prepare,… be better at disseminating that inf/information. You know, so the ability to share alerts coming from experts within, you know, Environment Canada or you know, other weather agencies, faster and more effectively, but just, I know it's easy to say, hard to do, but having more advanced knowledge and forecasting saying there's heightened risk, would allow us to do a better job" (P.G.L.1)*

- *"well, summertime, the population of the/of our area including/which is in part due to the hiring, swells by thousands. So the more people you have in a condensed area, the worse, those/those pos- risks could be. Ev-/so the last time a wind/big wind storm came through was in the summertime. Luckily the Pinery wasn't, there wasn't a lot of threat to the Pinery, but, if there were a lot of people in the Pinery at that time of year, if there was a large wind storm…, anything like that, the more people, than the more- yeah- riskier" (P.H.S.2)*

- *"obviously we have to be cognizant of… privacy considerations and/and, those aspects. But there's a wealth of information there about things like party size, ratio of parents to child, average length of stay, peak occupation periods... so there's probably a treasure trove of information there about some human activity elements in parks that/that could be mined to look at, you know, when are the riskiest time periods, in terms of park occupation, number of individuals in the park that would, you know, exacerbate response plans" (P.G.L.1)*

- *"we are still assessing. So but ya I mean we probably lost another 3 feet of shoreline, you know that's 10miles of our shoreline, and that's just the park, so/so but, so what's happening is our day-use accesses are gone so we are going to have to shut those down, a right now we are just getting around to our trails – we're trying to get to where the public go right now, and-a we will deal with that cause we want to manage any risk to the public and to ourselves obviously" (P.G.L.3)*

- "*there was just one [wind warning] again two days ago. So the/the issue that we have with wind warnings, is it's- you know, Northwest and Northeast that presents a problem for us in a wind warning. So it's not every one warning, but the wind warnings currently, given the high lake levels in the Great Lakes- which isn't expected to recede anytime soon, in combination with, I would say any winds that are greater than 50 kilometers an hour, present issues to our entire shoreline… I can tell you that we've had inland flooding in Port Franks, which is just South of the Pinery Park, which we've never had in 30 years because of that change. And I can tell you that we've had inland flooding in Grand Bend, as a result of those winds on River Road and right up, right up through there. And we've had some beach erosion in Grand Bend, as a result of all that" (L.G.M.1)*

Appendix C: Code Table

Phase 1 & 2 *Results from 4 Rounds of Code Generation*	**Phase 3 & 4** *1st Review and Reflect Group Codes into Themes*	**Phase 3 & 4** *2nd Review and Reflect Group Codes into Themes*	**Phase 3 & 4** *3rd Review and Reflect Group Codes into Themes*	**Phase 5** *Name, Define, Describe*

Adaptive Management
• Dynamic
	Build Back Better
	• Strengths
	  • Debriefs
	  • Experiential Learning
	• Weaknesses
	• Needs and Opportunities
		Build Back Better/Adaptive Management
		• Strengths
		  • Debriefs
		  • Experiential Learning
		• Weaknesses
		• Needs and Opportunities
			Adaptive Management
			• Strengths
			• Weaknesses
			• Needs and Opportunities
				Adaptive management allows for the continuous improvement of natural hazard risk management.

Best Practices	Collaboration, Coordination, and Partnerships
	• Strengths
	• Weaknesses
	• Needs and Opportunities
	  • Delineation of Responsibilities
	• External - Indigenous Communities
	  • Strengths
	  • Weaknesses
	  • Needs and Opportunities
		Collaboration, Coordination, and Partnerships
		• Strengths
		• Weaknesses
		• Needs and Opportunities
		  • Delineation of Responsibilities
		• External - Indigenous Communities
		  • Strengths
		  • Weaknesses
		  • Needs and Opportunities
			Collaboration and Partnerships
			• Strengths
			• Weaknesses
			• Needs and Opportunities
				Greater collaboration and partnership is needed to enhance natural hazard risk management.

	• Inclusivity
	  • Strengths
	  • Weaknesses
	  • Needs and Opportunities
	• External – Partners or Agencies
	  • Strengths
	  • Weaknesses
	  • Needs and Opportunities
	  • Inclusivity
	  • Strengths
	  • Weaknesses
	  • Needs and Opportunities
	• External – Public
	  • Strengths
	  • Weaknesses
	  • Needs and Opportunities
	  • Inclusivity
	  • Strengths
	  • Weaknesses
	  • Needs and Opportunities
	• Internal
	  • Strengths
	  • Weaknesses
		• Inclusivity
		  • Strengths
		  • Weaknesses
		  • Needs and Opportunities
		• External – Partners or Agencies
		  • Strengths
		  • Weaknesses
		  • Needs and Opportunities
		  • Inclusivity
		  • Strengths
		  • Weaknesses
		  • Needs and Opportunities
		• External – Public
		  • Strengths
		  • Weaknesses
		  • Needs and Opportunities
		  • Inclusivity
		  • Strengths
		  • Weaknesses
		  • Needs and Opportunities
		• Internal
		  • Strengths
		  • Weaknesses		

	• Needs and Opportunities
	• Inclusivity
	  • Strengths
	  • Weaknesses
	  • Needs and Opportunities
		• Needs and Opportunities
		• Inclusivity
		  • Strengths
		  • Weaknesses
		  • Needs and Opportunities		

Build Back Better Proactive Preparedness	Communication
	• Strengths
	• Weaknesses
	• Needs and Opportunities
	• External - Indigenous Communities
	  • Strengths
	  • Weaknesses
	  • Needs and Opportunities
	• External – Partners or Agencies
	  • Strengths
	  • Weaknesses
	  • Needs and Opportunities
	• External – Public
	  • Strengths
	  • Weaknesses
	  • Needs and Opportunities
	• Internal
	  • Strengths
	  • Weaknesses
		Communication
		• Strengths
		• Weaknesses
		• Needs and Opportunities
		• External - Indigenous Communities
		  • Strengths
		  • Weaknesses
		  • Needs and Opportunities
		• External – Partners or Agencies
		  • Strengths
		  • Weaknesses
		  • Needs and Opportunities
		• External – Public
		  • Strengths
		  • Weaknesses
		  • Needs and Opportunities
		• Internal
		  • Strengths
		  • Weaknesses
			Communication
			• Strengths
			• Weaknesses
			• Needs and Opportunities
				Enhancing natural hazard risk management requires greater communication.

	• Needs and Opportunities	• Needs and Opportunities		
Challenges	Politics	Politics	Knowledge Acquisition • Strengths • Weaknesses • Needs and Opportunities	Acquiring all forms of knowledge leads to more robust natural hazard risk management.
Climate Change	Knowledge Acquisition • Strengths • Weaknesses • Needs and Opportunities • Documentation • Site-specific Information • Informal Acquisition of Knowledge	Knowledge Acquisition • Strengths • Weaknesses • Needs and Opportunities • Documentation • Site-specific Information • Informal Acquisition of Knowledge	Knowledge Integration and Decision-making • Strengths • Weaknesses • Needs and Opportunities	All forms of knowledge should be integrated into natural hazard risk management. decision-making.
Debrief	Decision-making • Decision-making based on Risk • Behaviour General Decision-making	Decision-making • Decision-making based on Risk • Behaviour General Decision-making	Knowledge Sharing and Exchange • Strengths • Weaknesses • Needs and Opportunities	Natural hazard risk management. benefits when all forms of knowledge are shared and exchanged between all stakeholders.
Dynamic	Knowledge Integration • Strengths • Weaknesses • Needs and Opportunities	Knowledge Integration • Strengths • Weaknesses • Needs and Opportunities	Planning • Strengths • Weaknesses • Needs and Opportunities	Proactive planning is critical to successful natural hazard risk management.

Experiential Learning	Risk Context
	• Climate Change
	• Climate Change Information Needs
	• Positive Benefits from Climate Change
	• Risks Arising from Climate Change
	• Demographics
	• Design of Park
	• Public Safety
	• Strengths
	• Weaknesses
	• Needs and Opportunities
	• Perception
	• Recreation
	• Risk Acknowledgment
	• Number of Risks
	• Risk Naivety/Ignorance
	• External/Public
	• Internal
	• Risk Response
	  • Strengths
	  • Weaknesses
	  • Needs and Opportunities
	• Role in Risk Management
	• Seasonality
	  • Busy Season
	• Types of Risk
		Risk Context
		• Climate Change
		• Climate Change Information Needs
		• Positive Benefits from Climate Change
		• Risks Arising from Climate Change
		• Demographics
		• Design of Park
		• Public Safety
		• Strengths
		• Weaknesses
		• Needs and Opportunities
		• Perception
		• Recreation
		• Risk Acknowledgment
		• Number of Risks
		• Risk Naivety/Ignorance
		• External/Public
		• Internal
		• Risk Response
		  • Strengths
		  • Weaknesses
		  • Needs and Opportunities
		• Role in Risk Management
		• Seasonality
		  • Busy Season
		• Types of Risk
			Plans, Policies, and Regulations
			• Strengths
			• Weaknesses
			• Needs and Opportunities
				Natural hazard risk management. plans, policies, and regulations should be available and accessed.

	• Financial Risk
	• Legal Risk
	• Manmade Risk
	• Natural Hazard Risk
	• Public Safety Risk
	• Vulnerability
	  • Risk to Indigenous History
	  • Risk to Natural Environment
	  • Weather
		• Financial Risk
		• Legal Risk
		• Manmade Risk
		• Natural Hazard Risk
		• Public Safety Risk
		• Vulnerability
		  • Risk to Indigenous History
		  • Risk to Natural Environment
		  • Weather		

Mitigate Risk Unintended Consequences	Sources of Knowledge
	• Strengths
	• Weaknesses
	• Knowledge Ownership
	• Needs and Opportunities
	• Indigenous & TEK Knowledge
	  • Strengths
	  • Weaknesses
	  • Needs and Opportunities
	• Local Knowledge
	  • Strengths
	  • Weaknesses
	  • Needs and Opportunities
	• Natural Science Knowledge
	  • Strengths
		Sources of Knowledge
		• Strengths
		• Weaknesses
		• Knowledge Ownership
		• Needs and Opportunities
		• Indigenous & TEK Knowledge
		  • Strengths
		  • Weaknesses
		  • Needs and Opportunities
		• Local Knowledge
		  • Strengths
		  • Weaknesses
		  • Needs and Opportunities
		• Natural Science Knowledge
		  • Strengths
			Relationships
			• Strengths
			• Weaknesses
			• Needs and Opportunities
				Productive relationships advantageously aid natural hazard risk management.

	• Defensible Decisions • Ease of Implementation • Weaknesses • Needs and Opportunities • Social Science Knowledge • Strengths • Weaknesses • Lack of Applying Social Science Knowledge • Lack of Social Science Information at Scales • Perceived High Level of Risk • Needs and Opportunities • Mapping of Assets	• Defensible Decisions • Ease of Implementation • Weaknesses • Needs and Opportunities • Social Science Knowledge • Strengths • Weaknesses • Lack of Applying Social Science Knowledge • Lack of Social Science Information at Scales • Perceived High Level of Risk • Needs and Opportunities • Mapping of Assets		
Reversibility	Knowledge Sharing and Exchange • Strengths • Flexible Information	Knowledge Sharing and Exchange • Strengths • Flexible Information	Resources and Capacity • Strengths • Weaknesses • Needs and Opportunities	Availability of resources and capacity determine the success of natural hazard risk management.

	Sharing Approach
	• Weaknesses
	• Needs and Opportunities
	  • Knowledge Sharing at the Landscape Scale
	  • Large Organization
	• Indigenous & TEK Knowledge
	  • Strengths
	  • Weaknesses
	  • Needs and Opportunities
	• Knowledge Sharing Mechanisms and Tools
	• Natural Science
	  • Strengths
	  • Weaknesses
	  • Needs and Opportunities
	• Social Science Knowledge
	  • Strengths
	  • Weaknesses
	  • Needs and Opportunities
	• Tacit Knowledge
	  • Strengths
	  • Weaknesses
		Sharing Approach
		• Weaknesses
		• Needs and Opportunities
		  • Knowledge Sharing at the Landscape Scale
		  • Large Organization
		• Indigenous & TEK Knowledge
		  • Strengths
		  • Weaknesses
		  • Needs and Opportunities
		• Knowledge Sharing Mechanisms and Tools
		• Natural Science
		  • Strengths
		  • Weaknesses
		  • Needs and Opportunities
		• Social Science Knowledge
		  • Strengths
		  • Weaknesses
		  • Needs and Opportunities
		• Tacit Knowledge
		  • Strengths
		  • Weaknesses		

	• Needs and Opportunities	• Needs and Opportunities		

Risk Mitigation	Planning
	• Strengths
	• Weaknesses
	• Needs and Opportunities
	• Future Projections
	• Mitigation
	  • Strengths
	  • Weaknesses
	  • Needs and Opportunities
	• Precautionary Approach
	• Reversibility
	• Scenario Planning
		Planning
		• Strengths
		• Weaknesses
		• Needs and Opportunities
		• Future Projections
		• Mitigation
		  • Strengths
		  • Weaknesses
		  • Needs and Opportunities
		• Precautionary Approach
		• Reversibility
		• Scenario Planning
			Responsibility
			• Strengths
			• Weaknesses
			• Needs and Opportunities
				Natural hazard risk management is everyone's responsibility.

Collaboration Lack of Collaboration	Balance	Balance	Risk Monitoring and Evaluation • Strengths • Weaknesses • Needs and Opportunities	Natural hazard risk monitoring and evaluation informs management, especially in the face of climate change.

Collaboration, Partnerships and Coordination
• Collaboration/First Nations
• Informal Relationships
• Lack of Collaboration
	Plans, Policies, and Regulations
	• Legislation
	• Strengths
	• Weaknesses
	• Needs and Opportunities
	• Plans
	  • Strengths
	  • Weaknesses
		Plans, Policies, and Regulations
		• Legislation
		• Strengths
		• Weaknesses
		• Needs and Opportunities
		• Plans
		  • Strengths
		  • Weaknesses		

	• Needs and Opportunities
	• Emergency Management Plan
	  • Strengths
	  • Weaknesses
	  • Needs and Opportunities
	• Risk Management
	  • Strengths
	  • Weaknesses
	  • Needs and Opportunities
	• Policies
	  • Strengths
	  • Weaknesses
	  • Needs and Opportunities
	• Dual Mandate
	• Protocols
	• Strengths
	• Weaknesses
	• Needs and Opportunities
		• Needs and Opportunities
		• Emergency Management Plan
		  • Strengths
		  • Weaknesses
		  • Needs and Opportunities
		• Risk Management
		  • Strengths
		  • Weaknesses
		  • Needs and Opportunities
		• Policies
		  • Strengths
		  • Weaknesses
		  • Needs and Opportunities
		• Dual Mandate
		• Protocols
		• Strengths
		• Weaknesses
		• Needs and Opportunities

Inclusivity	Relationships • Strengths • Weaknesses • Needs and Opportunities	Relationships • Strengths • Weaknesses • Needs and Opportunities

	• Relationship with Indigenous Communities
	  • Strengths
	  • Weaknesses
	  • Needs and Opportunities
	• Relationships with Local Residents
	  • Strengths
	  • Weaknesses
	  • Needs and Opportunities
	• Relationship with Public, Visitors, and Tourists
	  • Strengths
	  • Weaknesses
	  • Needs and Opportunities
		• Relationship with Indigenous Communities
		  • Strengths
		  • Weaknesses
		  • Needs and Opportunities
		• Relationships with Local Residents
		  • Strengths
		  • Weaknesses
		  • Needs and Opportunities
		• Relationship with Public, Visitors, and Tourists
		  • Strengths
		  • Weaknesses
		  • Needs and Opportunities

Indigenous Communities
Indigenous & TEK Knowledge
	Trust
	• Indigenous Communities
	  • Strengths
	  • Weaknesses
	  • Needs and Opportunities
	• Local Trust
	  • Strengths
	  • Weaknesses
	  • Needs and Opportunities
	• Public, Visitors, and Tourists
	  • Strengths
		Trust
		• Indigenous Communities
		  • Strengths
		  • Weaknesses
		  • Needs and Opportunities
		• Local Trust
		  • Strengths
		  • Weaknesses
		  • Needs and Opportunities
		• Public, Visitors, and Tourists
		  • Strengths

	• Weaknesses • Needs and Opportunities	• Weaknesses • Needs and Opportunities
Local Residents	Values	Values

Need for Better Coordination	Resources and Capacity
	• Capacity
	  • Strengths
	  • Weaknesses
	  • Needs and Opportunities
	• Resources
	  • Financial Resources
	  • Strengths
	  • Weaknesses
	  • Needs and Opportunities
	  • Human Resources
	  • Strengths
	  • Weaknesses
	  • Needs and Opportunities
	  • Staff
	  • Strengths
	  • Weaknesses
	  • Needs and Opportunities
	  • Staff Training
	  • Strengths
	  • Weaknesses
		Resources and Capacity
		• Capacity
		  • Strengths
		  • Weaknesses
		  • Needs and Opportunities
		• Resources
		  • Financial Resources
		  • Strengths
		  • Weaknesses
		  • Needs and Opportunities
		  • Human Resources
		  • Strengths
		  • Weaknesses
		  • Needs and Opportunities
		  • Staff
		  • Strengths
		  • Weaknesses
		  • Needs and Opportunities
		  • Staff Training
		  • Strengths
		  • Weaknesses

	• Needs and Opportunities • Time • Strengths • Weaknesses • Needs and Opportunities	• Needs and Opportunities • Time • Strengths • Weaknesses • Needs and Opportunities
Partnerships	Accountability • External - Indigenous Communities • External – Partners or Agencies • External – Public • Internal	Accountability • External - Indigenous Communities • External – Partners or Agencies • External – Public • Internal
Communication • Communication/ External • Communication/I nternal • Public • With Partnerships and Agencies	Poor Data and Statistics	Poor Data and Statistics
Lack of Public Communication	Responsibility • To Mitigate Risk • To the Public • To the Tax Payers	Responsibility • To Mitigate Risk • To the Public • To the Tax Payers
Politics	Risk Monitoring and Evaluation • Strengths • Weaknesses • Needs and Opportunities	Risk Monitoring and Evaluation • Strengths • Weaknesses • Needs and Opportunities

Public Communication
Public Education and Outreach
Social Media
Informal Knowledge Acquisition
Knowledge/Lack Of
Knowledge/Access Enabling Factor
Knowledge Acquisition
Knowledge Gaps/Knowledge Needs
Knowledge Source • Experiential Knowledge • Long-term Experience • Multiple Sources
Knowledge Sources
You Don't Know What You Don't Know
Decision-making • Information Sources • Risk-based Considerations • Legal Elements of Risk • Reversibility • Seasonality • Development / Residential & Commercial

• Guiding Documents • Historical Documents
Factor in Risk Decision-making
Types of Risks • Manmade Risks • Natural Hazards • Financial Risks • Legal Risks • Public Safety Risk • Risk to Indigenous History • Risk to Natural Environment • Variety of Risks
Barrier • Funding • Human Resources • Legislation • Protocol • Natural Science Barriers • Policy Barriers • Social Science Barriers • TEK Barriers
Knowledge Ownership
Knowledge Sharing and Exchange

• Flexible information sharing approach • Knowledge Sharing at Landscape Scale • Knowledge Sharing Barrier/Risk • Knowledge Sharing/Prominence of Pinery
Knowledge Tools
Local Knowledge
Natural Science • Easy to Implement • More Concrete • Defensible Decisions • Ease of Implementation • Ecological Integrity Mandate • Lack of Natural Science • Staff Capacity
Risk Management Plan Not Available to the Public
Social Science • Barrier • Data Collection • Decision-making • Public Perception

• Lack of Applying Social Science Knowledge • Lack of Social Science Information a Scales • Perceived High Level of Risk • Social Science Potential to Improve • Social Sciences and Demographics
TEK • Barrier • Collaboration • Lack of Access • Relationship • Disregard for TEK and Consultation
Age/Demographic
Busy Season
Changing Demographics
Proactive Planning & Management
Risk Planning • Best Practices • Lack of Planning • Precautionary Approach • Scenario Planning

- Risks
  - Number of Risks
  - Types of Risks
- Scenario Planning
- Seasonal Variability in Risk
  - Seasonality/Increased Risk
- Significance of Business Model in Risk Management
- Visitor Experience
- High Visitation Rate
- Balance
- Dual Mandate Tensions
- Ecological Integrity
- Emergency Plan
- Park Mandate
- Policies, Plans, and Regulations
  - Regulatory Barriers
  - Emergency Management
  - Risk Management
    - Capacity
- Risk Management Plan
  - Re-design
- Risk Management Procedures
- Government Influence
- Relationships
  - Trust
- Values

Vulnerability
Available Resources
Capacity
Funding • Funding Barriers
Large Organization
Resources • Financial/Funding • Financial Barriers • Time/Lack of Time • Staff Training • Staffing
Staff • Staff Resources • Staff Training
Training
Accountability
Delineation of Responsibilities Unclear Roles
Responsibility
Risk Acceptance Assessing Risk
Risk Acknowledgment • Diversity of Risks • Public Safety Primary • Seasonality • Weather
Risk Exposure and Design of the Park
Risk Exposure and Recreation

Risk of Doing Nothing
Risk Response
Role in Risk Management
Future Projections
Historical Data
Monitoring and Evaluation
Need for Mapping of Assets
Poor Data and Statistics
Public • Public Engagement • Public Perceptions • Public Trust • Public Understanding of Knowledge • Visitor Demographics • Accessibility to Information • Behaviour • Education • Health and Medical • Involvement • Perception • Public Safety • Risk Naivety